CHAPTER ONE

SCIENCE, READING AND ACADEMIC PERFORMANCE

> Any person who hasn't developed the skill of reading to a reasonable extent is handicapped in our society for vocational, social, cultural and intellectual development are still largely dependent upon the ability to read. (Randall 1972:36, in Jardine 1985:59).

1.0 Introduction

All students need to read to pursue academic study, but many are not skilled enough in reading to do so. As a result, many are not able to follow their chosen careers and their futures could thus be jeopardised. This research study examines the effects of specifically teaching reading skills to a group of post-matriculant students whose first language is not English, and the possible relationship between their reading skills in English and their subsequent academic performance in their chosen field of study – Science.

The purpose of this chapter is to identify the research problem, to briefly review the issues addressed in the current study, to state the aims, objectives and research approach of the study and to outline the structure of the rest of this dissertation of limited scope.

1.1 Background to the research study

Thousands of students enrol for Maths and Science as well as commerce courses at tertiary institutions throughout South Africa, every year. The shortage of qualified personnel in these subject areas is well-documented in the media: in various reports collected in 2002 and 2003 from *The Citizen* and *The Star*, frequent reference is made to what is described by the education ministry as an 'endemic shortage' of high-level skills, particularly in the science and economic-based fields, such as engineering and information technology. More recently, an article appeared in the *Sunday Times* (7 November 2004) commenting on the 'pivotal role' that Science plays in the world and how South Africa is lagging behind in science fields compared to other developing countries, for example, Taiwan. Science is seen as the "cornerstone of human development and survival" (ibid.). The students, encouraged by offers of bursaries from

concerned sectors of the economy and government loans or bursaries, respond to this need by attempting to study for degrees in the sciences or commerce.

Equally well-documented are the reports from teachers, lecturers and education department surveys on the high failure and drop-out rate among the students studying in these fields at tertiary institutions. A Unesco report released at the end of 2000 and reported in *The Star* (2003) revealed that South Africa had the highest number of tertiary students in sub-Saharan Africa (633 918), yet the graduation rate of these students was only 15% compared to the ideal graduation rate of 33%. There are further reports that student numbers are shrinking and are forecast to continue to do so. The national throughput rate, which is defined as the number of graduates in any year as a percentage of total enrolment, for students of science, engineering, technology and commerce was only 16% (*Financial Mail* 28 January 2000:5).

This low pass rate has been attributed, in part, to poor language skills, particularly reading and writing skills. In an article in *Fair Lady* (August 2003), it was reported that the number of Grade 12 students who leave school functionally literate – able to cope with the demands of reading and writing necessary for daily existence – has dropped from 51% in 1990 to 18% in 2000.

As a result of these findings, some tertiary institutions are introducing admission tests. It is reported that six of South Africa's eight medical schools indicated that they were introducing their own entry examination for matriculants (*Fair Lady* August 2003). It is further reported from the Faculty of Engineering at the Pretoria Technikon that there has been a general deterioration in the content knowledge of Grade 12s of all races in core subjects such as English, Maths and Science (ibid.).

When one considers these rather alarming findings reported in the media, it would appear that there is a very real need for concern about the current educational situation in South Africa, particularly in the fields of Science, Maths and English. The situation is compounded by the fact that many of the students are English Second Language (ESL) students from previously disadvantaged backgrounds. (Currently, English as a second language is referred to as the language of learning and teaching – LoLT – but for ease of reference, the abbreviated term ESL will be used henceforth). In 1997 and 1998 the national throughput rate, across all

faculties, was 8% for black students as opposed to 25% for white students (*Financial Mail* 28 January 2000:5).

1.2 Factors contributing to the problems with language and the natural sciences in education

There are many reasons for the current situation in the teaching and testing of reading/writing for further Science/Maths study in the South African context. Besides the belief held by many Science/Maths teachers that the teaching of language skills (particularly reading and writing skills) or testing for literacy is unnecessary and too time-consuming, many Science/Maths teachers are not in a position to provide the students with adequate training in these areas. An article in *The Citizen* (2003) reported that according to a survey conducted by the SA Institute of Race Relations (2003), it was estimated that only 5 000 students graduate as teachers every year. The greatest shortage of teachers is in the field of Science and Maths. At least 12 000 teachers are needed to address the poor matric results in these two subjects. The article further reported that an audit conducted in 2001 by the Education Department showed that of about 350 000 teachers, 58 000 (i.e. 16,5%) were underqualified.. Many teachers are underqualified to teach generally and, more specifically, they are not qualified to teach Science/Maths. Their teaching methods are consequently poor and they are further hampered by a lack of textbooks and facilities. Even when provided with sufficient books and facilities, it was found that the teachers failed to use them adequately (*Financial Mail* 28 January 2000:4). As many of the teachers themselves are ESL speakers, their own knowledge of the language (and scientific discourse) is often inadequate and they rely on the oral transmission of knowledge, often in their first languages. Students in these situations often have a low literacy level anyway, and the only way they can learn is by rote memorisation of concepts they barely understand.

As a result, the matric results for Maths and Science have become a cause for concern. In 1997 the national pass rate reached its lowest level at 47,4% (*Fair Lady* August 2003:35). In an effort to raise this level (and because of underqualified teachers), many students were discouraged from attempting Maths and Science on the Higher Grade. This means that far fewer matriculants are able to comply with the university entrance requirements which are based on Senior Certificate matriculaion results and the m-scores allotted for the symbols achieved for the subjects written (cf. §2.2). It is reported that in 1998, 553 000 pupils sat

matric in South Africa. Only 20 000 (3,6%) passed Maths on the Higher Grade and 22 000 passed the natural sciences (*Financial Mail* 28 January 2000:3). It is from this small pool that the tertiary institutions have to draw their Maths/Science students. However, to further complicate the situation, this small pool of students is seldom adequately prepared for the demands of tertiary institutions with regard to language ability or ability in Science/Maths and they consequently fail or drop out.

The situation does not improve much as these students move on to higher academic study. Reading comprehension is seldom used in selection/admission testing – if it were, weak students could be identified and assigned to reading intervention courses. Such reading courses or any other general reading courses, thus far, have not been incorporated into the syllabi of all tertiary institutions. The Department of Education is attempting to address this situation by insisting that better introductory courses are offered by the tertiary institutions, but the lack of funds is hampering this initiative.

The current research study investigates the effects that a reading intervention programme has on the development of reading skills generally, and on the reading skills of ESL science students in particular, in an effort to ascertain what role this factor plays in academic performance at tertiary level.

1.3 Reading

Reading is regarded as a complex interactive skill as well as a meaning construction process, which involves both bottom-up or decoding processes and top-down or comprehending processes. "Skill in reading depends on the efficient interaction between linguistic knowledge and knowledge of the world" (Silberstein 1987:30). L2 reading involves " the interaction of an array of processes… basic decoding skills… higher level cognitive skills … and interactional skills" (Hudson 1998:44). Bottom-up processes refer to the ability of a reader to move from letter to letter, to word, to phrase and finally to sentence. The reader then progresses to paragraphs and so on. Initially this is how children learn to read. In order to achieve this, a reader has to have phonic skills and visual short-term memory skills. These skills broaden holistically to include analytical, perceptual skills, and whole word recognition skills. These

skills then further develop to include rapidly and accurately recognising lexical and grammatical forms (automaticity) in order to understand the text.

Top-down processes involve "conceptually-driven information processing" (Silberstein 1987:31). Readers draw on prior knowledge to predict what they might find in a text and to construct meaning while they read. This prior knowledge is divided into schemata – theoretical frameworks of knowledge about text structure and about the subject of the text – which are activated as a person reads. A reader "applies schema, both formal and content, to the text in order to create meaning that is personally and contextually sensible to the reader" (Hudson 1998:47). The abilities involved in this process include comprehension skills and strategies, such as inferencing, learning to define goals and expectations, learning to read for global meaning and making predictions. Maturing readers also have to develop their metacognitive skills, that is, the ability to "think and talk about language as an object" (Taylor 1990:268) and monitor their own thinking and reading processes. When reading, a good reader is "monitoring understanding; and noticing, understanding, and integrating meaningful relationships within the text, and determining what is important" (Van Wyk 2002:221). Metacognitive skills involve both decoding and comprehending processes, for example, knowledge about language strategies – using a dictionary – and employing comprehension strategies – underlining or summarising information. Further strategies in this component of reading are adjusting reading rate, skimming portions of a text and using morphological information to guess at word meanings. Skills monitoring includes being aware of noncomprehension, and utilising self-regulation strategies, such as testing self-comprehension.

Reading is thus considered to be a very complex process. The component skills needed for reading interact simultaneously to allow the reader to comprehend what s/he is reading. In summary, Grabe (1991:379) lists six general component skills that one needs in order to read interactively and successfully:

- automatic recognition skills
- vocabulary and structural knowledge
- formal discourse structural knowledge
- content/world background knowledge
- synthesis and evaluation skills

- metacognitive knowledge and skills monitoring.

Further, Taylor (1990:286) suggests other skills that a reader uses when faced with an expository text, for example, a science text. Readers have to identify the discourse topic; distinguish important from unimportant details; follow a sequence of directions or logical ideas; draw inferences and conclusions, and finally, extract the gist of the passage. In addition, skilled reading requires practice and effort, and develops gradually over the years.

From this discussion, it seems obvious that any breakdown in bottom-up or top-down processing can inhibit the reading process. Many ESL students often do not have the necessary background knowledge to process expository texts, and many others are still 'stuck' in the decoding phase of reading. The latter students also tend to read slowly, thus further hampering their meaning construction.

1.4 The importance of reading

Reading is regarded as a vital skill for academic success (Carrell 1989, in Pretorius 1996:45). When students reach secondary and tertiary levels, they need to be able to 'read to learn'. The teacher/lecturer cannot supply all the information needed for a thorough knowledge of the subject and extra information has to be sought in textbooks. Furthermore, textbooks provide the basis of what has to be learnt. Students cannot recall all the information heard during a lesson and textbooks provide the means to consolidate what has been taught to fill the gaps, as they can constantly be referred to and consulted. Students also have to learn to study independently and produce assignments and for this they need to consult prescribed books. Weak reading skills will hinder their progress at higher institutions, yet reading is still viewed as the responsibility of the English teacher or lecturer. Teaching reading across the curriculum (i.e. reading for learning purposes in all subjects) is regarded with trepidation by teachers/lecturers of other subjects because of time constraints and syllabus demands. Many Science/Maths teachers feel that such reading is of little value in their subjects. They treat with disbelief the notion that without the necessary reading skills, the students cannot cope with the demands of their subjects. Others, on the other hand, are well aware of their students' limited reading skills, but are at a loss as to how this problem can be rectified.

1.4.1 Reading and textbooks

Access to learning materials such as books and stationery is considered to be one of the most important predictors of intellectual development (*Financial Mail* January 28 2000:4). International research has shown that textbooks have a positive effect on students' learning, in particular on Science and Maths: "one of the most important ways of improving the quality of maths and science learning is through the provision of standard teaching materials" (ibid.). Yet textbooks, which offer the students practice at reading, reading independently and which provide stimulus for more enthusiastic further study[1], are often ignored by the teachers who claim that the texts are too difficult for the students to read, or are too inferior. This belief was echoed by former Minister of Education, Sibusiso Bengu, when he stated that "My advisers tell me that learners do not need textbooks" (*Financial Mail* 28 January 2000: 4). Many teachers are ESL speakers themselves and often their own low level of comprehension and reading ability precludes them from understanding or using textbooks properly.

In addition, in South Africa, adequate reading materials are not provided for all schools as a result of insufficient funds allocated from the national Department of Education. Besides the lack of expenditure on textbooks, the distribution of available textbooks is inefficient because of the abuse of the approval system, the ordering process, the tendering process and the payment system. The approval system is flawed because of the inconsistent decisions of the various provinces. In addition, many of the evaluators are often unskilled and certain unprofessional practices have been adopted, for example, some provincial education departments charge publishers for the submission of textbooks and then refuse to reveal why a textbook has been rejected. Orders by certain education departments are reported as being consistently late and this results in delays when publishers are out of stock. Tenders have been encouraged to support black economic empowerment but negligence in managing the process has also resulted in inefficient deliveries. Finally, publishers are not being paid for the books they have delivered. It is reported that by the end of August 1999 publishers were owed R54 million by education departments and distributors for stock delivered at the beginning of 1999 (*Financial Mail* 28 January 2000:4-5). The resultant situation is simply described: the textbooks do not reach the students, particularly those in rural areas.

[1] Learners, particularly those from disadvantaged backgrounds, were found to work harder and more enthusiastically with workbooks - both at home and at school (*Financial Mail* January 28 2000:4).

Despite these problems, large numbers of textbooks are available, but even when adequate reading materials are provided for students and are used by the teachers, it is estimated that only 15% of the students' time in the classroom is spent reading and one-fifth of that time is devoted to silent reading for study purposes (ibid.).

1.4.2 Reading, vocabulary and science texts

The study of Science, in particular, relies heavily on understanding word problems which in turn involve both general reading and vocabulary skills. Vocabulary knowledge plays an important role in the reading comprehension of Science texts as students need to know technical words (*force, density, gravity*), academic vocabulary (*calculate, exemplify, principle*), as well as general words like *astronauts, cliff, roller coaster.*

Science texts are considered to be 'dense' in that they contain large amounts of factual knowledge which is conceptually complex. These texts are more demanding for the reader because they are less predictable than narrative texts and they have a more formal structure than other texts. In addition to the use of passive voice rather than active voice, these texts make frequent use of semantic relations, for example, causal relations signalled by conjunctives such as *since, therefore*, which the students need to recognise and understand but seldom do. Understanding instructions or examples is another area where difficulties arise for the students, even though they might well know the applicable scientific formulae. Without the necessary reading and vocabulary skills, ESL students have difficulty comprehending these expository texts and so find learning or gleaning more information from them problematic.

1.5 The research context of the current study

The private College at which I teach is situated on the Wits Education Campus (formerly JCE). Black post-matric ESL students come to the College from throughout South Africa; they reside in residences on the campus and are exposed to campus life. These students are bridged for an academic year in Grade 12 Maths and Science to rewrite the National Senior Certificate Examination in these two subjects. They also study English Communication, Computer Skills, Life Skills, Business Skills and Technical Drawing. The students are privately sponsored by

concerned companies who then offer bursaries for further tertiary study to those students who achieve excellent results in Maths and Science.

1.5.1 Admission to the College

Various testing methods have been adopted over the years for students to gain admission to the College. The students are tested on their performance in Science and Maths by means of a multiple choice test developed (and refined over 12 years) by my colleagues who teach these subjects to our students. The test attempts to guage performance in Maths and Science, based on the knowledge that the students should have gained by post-matric level. The students' matric results in these two subjects are also taken into consideration. They are also interviewed by the Management of the College and the teachers. In the past they were also required to write a short essay in English on where they saw themselves in five years' time, but they are no longer required to do this. Their essays were marked by the English and Life skills teachers. Marks were awarded for style, language and creativity, like that of general essay writing. The students were not tested in reading comprehension nor in vocabulary.

For the past two years, a general aptitude test assessing all facets of ability, developed by the HSRC, as detailed in §3.8.1, has been administered to the students. This test does assess certain vocabulary items, for example, synonyms, and also tests aspects of reading comprehension, but no written component is included in the test. The students still write the internal Science/Maths test and are also interviewed. The admission testing of the College has thus not been uniform, nor is it standardised.

As a result, we have had many experiences of discrepancies in the students' abilities in Maths, Science and English, and their subsequent performance in these subjects. Students who are proficient in spoken English are often functionally illiterate and do not achieve in Maths and Science either. Others who have shown little spoken or written language competence in the admission tests, have achieved A symbols for the hard sciences at the end of the year. Still others have sound language skills and either improve greatly in Science and Maths during the year or remain weak in these two subjects.

As stated previously, our students are all sponsored by concerned companies in the private sector and those students excelling in Maths and Science are offered bursaries for further tertiary education. These companies obviously expect good academic results in return for their investment and so reliable testing procedures are necessary to ensure this.

1.5.2 Learning problems experienced by the students

After teaching English communication skills to hundreds of students over twelve years at the College, I have found that the same learning problems recur year after year. Most of the students can speak English, but their language proficiency often stops there. Few have the necessary reading or writing skills to cope with the academic standard that is expected of them, as they proceed to tertiary level. Many do have ability in Science (and Maths) as indicated by their results, but unless they have English language skills (particularly reading and writing skills), their chances of success at tertiary level are doubtful, as has been proven over the years. The most common academic/learning problems that these students experience are discussed in the sections that follow.

1.5.2.1 Language problems in Science texts

There have been many anecdotal reports from my colleagues about how Science (and Maths) lessons become language lessons (in reading and vocabulary) before scientific principles can be dealt with. For example, the principle of gravity is explained in the Science textbooks in terms of astronauts in space. Some of the students do not know what an astronaut is and so this has to be explained first before the lesson can continue. In the vocabulary test developed for this research, 57 of the original 91 students (63%) who wrote the test did not know what an astronaut was.

The inability to follow instructions is another often-heard complaint. The students often do not understand the terminology of instructions in their Science textbooks and so have difficulty in executing these instructions. Words like *precede*, *concentrate* and *contrast* confuse them and they thus frequently fail to carry out the experiment correctly or to solve the problem presented. As a result, the Science teachers complain about the level of language of the textbooks which they claim is above the students' ESL reading ability. The Science teachers

often therefore do not use the prescribed textbooks and prefer to create their own notes. While this method is definitely beneficial for the students in the short term, it unfortunately discourages them in the long run from reading their textbooks to find further information, that is, 'reading to learn'. Furthermore, this method does not equip the students with a knowledge of scientific discourse which is needed to read and understand scientific texts.

1.5.2.2 Reading problems

From my own experience in the English Communication classroom, the actual reading of the instructions also presents a problem. Reading is a complex interactive skill involving both top-down and bottom-up processing. Many students have weak bottom-up processing skills and read inaccurately – *support* becomes *purpose*, for example. As a result, their top-down processing or comprehension is affected. In the internal English examination written at our College in September 2003, 43% of the students failed to read their instructions properly and so answered the questions incorrectly and lost marks.

Most of our students are also reluctant to read. They have had little exposure to books in their homes and at school, and often their communities do not realise the importance of reading for pleasure which would then equip young readers to cope with more complex texts at school, and thereafter at tertiary level. According to a report, "Getting Learning Right" (*Financial* Mail January 2000:4), little practice takes place in reading and writing in black schools. Learners have been taught to learn by rote memorisation, as mentioned before, and learning by self-discovery through their own research is an alien concept to them. However, once exposed to extensive and intensive reading tasks, they seem to realise the importance of developing reading skills and very often become avid readers. In the questionnaire I developed for this research, all of the students acknowledged that reading was important for their language development, but very few read independently outside of the classroom – reading was considered to be a teacher-supervised activity during class time.

Finally, most of the students read very slowly. Many students subvocalise (i.e. mouthe the words as they are silently reading) or even quietly vocalise the words and use their fingers to point to the words in a text. The average reading rate in the pretest devised for this research was 121 words per minute in the intervention group. According to research (e.g. Bohlmann &

Pretorius 2002), this is far below the reading rate deemed necessary (160 wpm) to cope in an academic environment. This will be further discussed in §2.5 and §4.4.2.3.

In addition, students often become 'stuck' on words. If they are not taught to guess from context while reading, they fixate on a word they do not understand and this hinders their ability to understand the sentence or passage they are reading. Vocabulary skill training, which includes guessing meaning from context and using morphological clues, thus becomes vital in reading skills' training for students.

1.6 Summary of the preceding discussion

Reading is a vital skill for academic success, yet little is done to instruct students in reading and vocabulary skills. Both the latter are essential skills for the study of Science, but again these skills are not specifically taught to the students. Consequently, the students have great difficulty with Science and many fail the subject or drop out of the course because they cannot cope with the academic and language demands at tertiary level. In addition, language testing procedures and remedial courses are not adequate enough to assist these students as they begin their tertiary careers at universities or technikons. The result is a low percentage of graduates who can offer their skills in an expanding economy that requires a high percentage of qualified scientific (and commercial) personnel.

Very little information seems to be available on the possible link between reading comprehension and academic success in Science. This research study hopes to explore this relationship. A reading intervention programme was established that involved reading strategy training and vocabulary instruction, using scientific texts. It was hoped that by practising reading through greater exposure to scientific texts, the students would benefit in all areas of their studies, but particularly in the study of Science.

1.7 Research aims

This research aims, firstly, to examine the effect of an intensive reading course that includes vocabulary strategy training, on the students' reading abilities in English during a year's bridging course. The students worked from a commercially available reading workbook in the

classroom, with teacher supervision, for two hours every week. Reading strategies, such as skimming, scanning and summarising were specifically taught to the students and they practiced these strategies regularly, using the scientific expository texts from the workbook. In addition, comprehension skills were strengthened and vocabulary learning strategies, such as the use of dictionaries, were also taught and practised. The reading course provided opportunities for the students to practise reading generally and to read scientific texts, specifically.

Secondly, this research investigates the possible relationship between the teaching of reading comprehension skills and strategies (including vocabulary skills) and academic achievement in Science for post-matric (ESL) students in a bridging course of one year. Initially, the intensive reading course was implemented with a pilot group of 16 students for a term in 2002. A class of 13 acted as the control group. Problems were identified and rectified for the main study, which was implemented for the academic year of 2003. An intervention group, originally consisting of 66 students, followed the intensive reading course, while a group of 23 students at another, but similar institution, continued with their usual English syllabus. The latter group functioned as a kind of control group against which to compare the performance of the intervention group. However, in the main study, the control and intervention groups were renamed Treatment Group 1 and Treatment Group 2 respectively, for reasons that will be detailed in Chapters Three and Four. Both groups wrote the same pre- and posttests.

1.8 Research questions and hypotheses

The research questions that are posed and the corresponding hypotheses that are proposed in this research are as follows:

1. Will a reading intervention programme conducted during the course of an academic year (about eight months) contribute to an improvement in reading skills?

H1: *After an eight-month reading intervention programme (incorporating vocabulary strategy training) with an intervention group (Treatment Group 2), there will be a significant difference in the reading abilities of the intervention (Treatment Group 2)*

and control (Treatment Group 1) groups respectively, as reflected in the pre- and posttest reading scores.

2. Will improved reading skills as a result of a reading intervention programme contribute to greater academic achievement in a subject like Science?

H2: *There will be a significant relationship between academic performance in Science and reading ability.*

1.9 Conclusion

This chapter has identified and discussed some of the problems associated with ESL students' reading and writing skills and the impact this has on the study of Science, together with their academic performance in this subject. The rest of the dissertation is structured as follows: Chapter Two reviews the research conducted in the fields of reading ability, academic performance and performance in a subject like Science. Chapter Three describes the implementation of both the pilot and main study, and discusses the findings of the pilot study. Chapter Four describes and discusses the findings of the main study of 2003. Chapter Five includes the conclusions drawn from the study, its limitations and its contributions to research in reading. The implications for further research in reading are also discussed in this final chapter.

CHAPTER TWO

REVIEW OF THE LITERATURE

2.0 Introduction

In this chapter the literature pertaining to the current study will be reviewed and discussed. The discussion of the literature has been divided into subsections which relate to the various aspects of the current study. Firstly, the relationship between reading, vocabulary and academic success will be discussed. Thereafter, studies relating to reading and admission testing, as well as reading and its relationship with an academic subject like Science will be reviewed. Research findings regarding reading intervention programmes and their implementation are also presented in this chapter. Finally, research designs and techniques for the assessment of reading ability are reviewed.

2.1 Reading and academic success

The large drop-out and failure rate of ESL students at tertiary institutions is a cause for concern among the academic staff of these institutions. One of the reasons cited for this phenomenon is that the students have poor language skills, particularly with regard to reading and writing. This situation is not unique to South Africa, as indicated by a study in the USA conducted by Raphan & Moser (1994). These researchers state that for many years universities have been admitting ESL students who are ill-prepared academically in all facets of language skills (reading, writing, listening and speaking). The researchers comment that it is often only after examinations in the content-area that the lecturers discover that the students did not understand the lectures. In South Africa, Jardine (1985) refers to the ESL student as ‘at-risk’ and ‘academically vulnerable’. He cites many reasons for this, for example, the lack of qualified teachers in schools, the lack of facilities and suitable textbooks, but he maintains that the greatest lack experienced by these students is that of ‘languaging’ (Jardine 1985:58). The ESL students studying at tertiary institutions simply do not have the necessary language skills to cope with the language demands of an academic environment.

Further research has narrowed these findings (Grabe 1991; Pretorius 1996; Coady 1993; Dreyer 1998; Ulijn & Salager-Meyer 1998). Reading is now considered by many as the single most important skill required for academic success – "after all we do still 'read' for a degree" (Jardine 1985:59). Rangappa (1993:25) further comments that reading is a rich resource for all humanity because it provides "an impetus to think, understand, interpret and reason out."

Perkins (1991) investigated the reading and vocabulary abilities of students registered at the University of Transkei (Unitra). It was found that the students were largely inadequately prepared for an academic environment. Using the STEP reading survey which tests reading skills, it was established that 53% of the 258 participants tested were considered 'at risk' at the start of their academic careers. Further, in this survey, 48% of the Science students were at risk. After using a second test – the Stanford Diagnostic Reading Test – results indicated that only 13,8% of the students had the necessary reading skills to comprehend first-year textbooks.

The language of books differs from the more informal language of spoken discourse which relies on listening and speaking skills as well as verbal communication. This distinction is referred to as the BICS/CALP distinction. BICS refers to basic intercommunicative skills, that is, the more informal language of spoken discourse. However, once students are exposed to reading textbooks for information, they need to be proficient in CALP – cognitive academic language proficiency (Cummins 2000:58). Oral and written language differ in many regards, for example, in syntactic structures and the use of vocabulary. (The latter aspect will be more fully explored in §2.1.1). The poet T.S. Eliot once commented: "If we spoke as we write we should find no one to listen; and if we wrote as we speak we should find no one to read" (Taylor 1990:42).

'Book language' or written language requires students to be able to read and to comprehend complex syntactic structures which do not commonly occur in spoken discourse, such as passives, embedded clauses and nominalization. Familiarity with book language also requires familiarity with text structure. The written word makes demands on students' vocabulary and spelling knowledge and it challenges their knowledge of semantics, for instance, knowledge about the relationship between words. It also requires knowledge of the relationship between chunks of information, for example, causal relations that hold between information in clauses, adjoining sentences or paragraphs. When students move on to tertiary education, the ability to

read and comprehend becomes vital. ESL students, especially, are at risk in this situation. The purpose of schooling and study is to acquire new information and most of that information is found in books. Students therefore have to acquire CALP, as their former BICS will not help when faced with formal expository texts. At tertiary level, students use their textbooks and reference books to supplement their lecture notes. If they cannot understand the language of these books, then they cannot glean more information or learn independently. Good reading skills thus become crucial at this academic and cognitive level as students now need to 'read to learn' more than ever before.

A further complication with regard to textbooks is that, very often, the reading level of the textbooks is above that of the student population for which they are intended (Braselton & Decker 1994:276) and thus the situation for the 'at-risk' students becomes even more disadvantageous. This situation also prevails in South Africa, as mentioned earlier in §1.2.1.

In the South African context, Pretorius (1996:35) has supported the notion that academic success is linked to reading skill: "Poor scholastic performers are also poor readers." The researcher describes good readers, because of their comprehension skills, as "generative", that is, constantly adding new knowledge to their schemata as well as refining and adapting their reading strategies. Conversely, poor readers are 'inert' and rigid. They cannot move beyond their decoding abilities to the comprehending skills. In time, poor readers become weaker at all levels "in terms of cognitive, language, literacy and academic skills" (Pretorius 1996:36) compared to the good readers, who become more academically successful – in reading research, this is termed the "Matthew effect" (Pretorius 1996:36)[2]. The phrase was first coined by Keith Stanovich in 1986.

The students at our College all enrol at tertiary institutions for degrees in Science after the bridging year at the College. Very few are able to cope with the academic demands of their studies and many drop out or pursue different courses. A common complaint from these students is the great amount of reading they are expected to do, coupled with the need to comprehend complex types of texts (i.e. expository) that this reading entails. It would seem that exposure to a reading programme during their bridging year might better prepare them for

[2] This term comes from a biblical reference in Matthew 25:29 in the New Testament: *For to every person who has something, even more will be given, and he will have more than enough; but the person who has nothing, even the little he has will be taken away from him.*

what lies ahead. (In the current study an intensive reading programme was introduced, cf. §2.4).

2.1.1 Reading and vocabulary

A further aspect of reading skill that is relevant in this discussion is that of the relationship between reading comprehension and vocabulary. Skilled readers tend to have a larger vocabulary than weaker readers, as the result of a more constant and greater exposure to the printed word (Daneman 1991:525, in Bohlman & Pretorius 2002:200). Skilled readers' word recognition skills appear to be greater than those of the less skilled reader; their lexical access is easier if words are recognised in print and they are better able to infer new meanings from context if they recognise new words while reading texts.

Reading is described as an interactive process which involves background knowledge (top-down processing) as well as word recognition and text processing (bottom-up processing). Reading is described as "a dynamic event in which the reader generates meaning by negotiating text and context" (Siegel & Fonzi 1995:635). So, in addition to understanding the context of what is being read, the students have to understand the language of that text, that is, the words. Sight word recognition and phonetic decoding skills are therefore vital to the reading process. It is estimated that, while an English native-speaking university student will know about 20 000 words, the ESL student will probably recognise and know far fewer words (Nagy & Anderson 1984, in Nation 1990:11). 'Words' in the latter estimation refer to lexical items. In a later study (Laufer 1992, in Cooper 1999:38), it is proposed that a basic knowledge of 3000 word families, that is words and their derivations and inflected forms, is required for a reader to comprehend the meaning of a text written in a second language.

In vocabulary studies, three main categories of words are described. In the first, the students have to recognise (and understand) *high frequency* words which are used regularly in spoken and written discourse, for example, *recognise*, *manufacture*, *typical*, *apply*. Students also have to recognise very high frequency words such as *the*, *it*, *can*, *know*. It is estimated that there are 2 000 such common words in English and that 83.4% of the text will be drawn from these words (Cooper 1999:37). The students also have to know low frequency words, that is, *academic* and *technical* words which they will encounter in the reading of expository texts and

also in academic discourse. Although these words do not commonly occur in everyday spoken discourse, they are considered high frequency in the aforementioned texts and discourse. *Academic* words are used in academic discourse across discipline boundaries, for example, words such as *evaluate, technique, coincide, category* etc. One of the first lists of these words was produced by Nation (1984, in Nation 1997:239) and contained approximately 850 words. It is estimated that about 8.5% of any academic text contains these words. (Cooper 1999:37). A knowledge of the high frequency words together with the academic vocabulary would provide a 91.9% coverage of an academic text. This approaches the 95% that is advocated in order for a reader to comprehend the contents of a text (ibid.).

Besides these words, students also have to deal with *technical* vocabulary – words which relate specifically to the subject they are studying. Examples of these words in Science are *data, alloy, nucleus, mass,* etc. There is also another category of words that readers need to know and process – these are words signifying semantic relations in texts, for example, temporal relations (*X then Y*). The latter category of words will be discussed in more detail in §2.3. Research studies such as Cooper's (1999) suggest that a knowledge of low frequency words is associated with academic success. Students who do not read much are not exposed to the low frequency words and consequently have lower vocabulary levels, which makes them weaker students than students who are skilled and frequent readers.

Vocabulary knowledge is vital in reading comprehension (as well as being a consequence of reading) and it is claimed by many researchers to be one of the best predictors of reading comprehension (Davis 1968, in Bohlmann & Pretorius 2002:200). In Cooper's (1999) study it was found that students who had lower vocabulary levels, especially of academic words, were academically weaker than those with larger academic vocabularies. In order to boost the poor vocabulary levels of students, many researchers argue that vocabulary strategy training should be taught in conjunction with reading skill development. Researchers such as Coady (1993); Grabe (1991) and Ulijn & Salager-Meyer (1998) comment on the importance of including such strategy training to increase vocabulary knowledge in a reading course because "... it is now widely accepted that vocabulary knowledge is a critical component of reading comprehension..." (Ulijn & Salager-Meyer 1998:81).

While the reading programme I used did not specifically teach vocabulary strategies, as facilitator I taught strategies such as the use of dictionaries, guessing from context, identifying morphological clues and semantic relations to the intervention classes as part of the reading course.

2.2 Reading and admission testing

As mentioned earlier in §1.2, students are often not tested for reading comprehension ability (or writing ability) before they begin further study after matriculating. They are rather tested, if at all, for general language proficiency, which includes oral ability. The myth persists in South Africa that if an L2 student can speak English, then s/he can also read (and write) the language and will therefore achieve academically. This belief does not take into account the BICS and CALP distinction (Cummins 2000:58), mentioned in §2.1. American research such as that of Saville-Troike (1984) suggests that reading achievement in English is more dependent on L1 reading ability than on oral proficiency in English (based on qualitative information), while later studies (e.g. Taillefer & Pugh 1998) found that L2 language proficiency was a stronger predictor of competency in L2 reading than L1 reading competency. Such research is not always applicable to South Africa, because coming from cultures that rely mainly on oral tradition, very few of our ESL students read in their L1. As a result their L1 reading abilities may have little influence on their ability to read in their L2, which in this case is English. Nevertheless, oral proficiency as a predictor of reading/writing success or language proficiency in an L2 was not considered as an important variable in L2 reading comprehension in either Saville-Troike's (1984) or Taillefer & Pugh's (1998) studies. It would seem then that assessing students' oral competence would not predict their future academic performance unless the assessment taps into CALP abilities as well.

Reading comprehension is regarded as one of the most important predictors of academic success and should therefore be assessed before further tertiary study is embarked upon. If one is to improve academic performance in any subject, one needs to concentrate on improving reading skills and this can only be done by practising reading itself. Reading ability and language proficiency are often confused in testing procedures. They are mistakenly assumed to be the same thing and what is meant to be a reading test becomes a general language proficiency test which relies on grammatical and vocabulary knowledge. These two skills are

certainly related, but improving language proficiency does not necessarily improve reading comprehension (Hacquebord 1994, in Bohlmann & Pretorius 2002:196). Conversely, reading can improve language proficiency: "comprehensible input gained in reading, however, may contribute to a general language competence that underlies both written and spoken performance" (Krashen & Terrell 1983, in Hafiz & Tudor 1989:5). In Mason and Krashen's (1997) study involving the use of extensive reading with three groups of students, it was found that the results of the researchers' measure of writing also confirmed that an improvement in writing had occurred, after a semester of extensive reading (cf. §2.4).

If a relationship between reading comprehension and academic success can be established, then admission testing procedures at tertiary institutions should be introduced or modified to include reading comprehension (and writing) tests. Perhaps Science students should be assessed on scientific performance and reading comprehension before they embark on a degree in the hard sciences. If found to be weak in reading and writing skills, then such students could possibly be enrolled in programmes which would specifically develop these skills while they are studying the sciences. If found to be weak in the sciences as well, perhaps career/ choice of degree counselling would be a better option for such students.

Currently in South Africa, many admissions to tertiary institutions (cf. §1.2) are dependent on the Senior Certificate matriculation results and the m-scores allotted for each symbol, for example an A = 5. Each degree requires a certain m-score and in some cases, for example in a B.Sc degree, C and D symbols on the Higher Grade in Maths and Science are also required. These requirements vary from tertiary institution to tertiary institution. For example, at RAU, the m-score required for entry into a B.Sc degree is a minimum of 14 points. Further tests are not always used to assess any other aspects of the students' abilities, such as reading and writing skills. Certain universities in South Africa, for example, UPE, UNISA and UCT, are including literacy/numeracy proficiency tests in their Science faculties with a view to channelling weaker students into support programmes or redirecting their academic paths, but this does not appear to be the norm yet for all universities in South Africa. In the two colleges involved in this research, different tests are used (as detailed in §1.5.1 and 3.7.1) and the tests are not uniform from year to year.

Jardine (1985) recommends that before registering at a tertiary institution for the first time, all students should be required to write an entrance examination which tests language skills. Although he refers to all language skills, reading should obviously be one of them. The students identified as being in need of support should be "forced or encouraged" (Jardine 1985: 62) to take a language course especially structured to cater for their needs, that is, English for Special Purposes courses that are fully credited and not simply an easy option. He elaborates by saying, "(b)y this I mean that students registered for Science degrees should get practice in particular scientific registers ..." (ibid.). Courses such as these are offered in other parts of the world, for example, Britain and USA, and despite the costs involved, Jardine advocates the implementation of intervention courses for South Africa as well, in the interests of preventing the waste of money that drop-out rates and failures cause.

Several South African universities have implemented such courses. However, it would appear that the curriculum seems to focus more on writing and language, rather than reading. Recently the University of the Free State implemented a bridging course focusing specifically on academic reading and writing skills for students from previously disadvantaged school systems (Van Wyk 2002). Thus far, the effectiveness of these courses and their impact on academic performance has not been reported on or established.

Objections have been raised to pre-testing students before they embark on a tertiary degree on the grounds that this would be a way of discriminating against weaker students, among them ESL students. In the USA, Patowski (1991) warns against such testing procedures in his research investigating the various admission/ placement tests of English language proficiency used in the USA and he questions the predictive value of these standardised tests. He examined the entrance and academic records of 271 students in the ESL programme at Brooklyn College in New York over three years. The data collected were those of the entrance test scores in reading, writing and Maths (the basic skills) and the academic performance results in course work. After analysing the data, the researcher found that the Maths result was the best predictor of the grade point average and the writing result was the weakest, even though the correlation was very modest (Maths r =.344, reading r = .255 and writing r = .169).

His two conclusions from the findings were, firstly, that the entrance scores on the basic skills tests were not good predictors of subsequent academic success. Secondly, reading and writing

scores had even less predictive value than the Maths scores. He suggested that there were problems associated with basing educational decisions on standardised placement instruments for minority language students. From this it would seem that he was more concerned about the construct validity of the tests themselves, rather the principle of admission testing per se. His final recommendation then was that important decisions on the future placement of students should not just rest on a single score on any single test, but should rather "depend on a wider, more 'authentic' base of information." (Patowski 1991:738). In this way ESL students would not be restricted in their attempts to gain access to higher education.

Patowski's (1991) research was, as mentioned earlier, conducted in the USA which is regarded as a first world country with high literacy levels. South Africa, on the other hand, is a developing country with high illiteracy and semiliteracy levels. Thus, despite the findings of Patowski's (1991) research, the use of valid assessment instruments in South Africa for reading and writing skills as well as for other areas, for instance Maths, could be used to the students' advantage to ascertain their weaknesses and recommend enrichment courses to address their situation.

The reading programme that was used in this study addresses scientific texts and vocabulary and is, in my opinion, a bridging or enrichment treatment to aid students in English for special purposes. The findings of this intervention programme could provide useful information for decisions taken about testing procedures, before students embark on further academic study.

Having established the value of reading in the academic and pedagogical context, the following link I shall now examine is that of the relationship between reading ability in general and the level of reading ability needed for scientific expository texts.

2.3 Reading and Science

Science texts, due to their specific nature, impose certain demands on readers. As explained earlier in §1.4.2, the study of Science relies heavily on word problems and explanations which in turn involve both general reading and vocabulary skills. Science texts contain an 'information overload' (Johnstone 1985, in Jardine 1985:60) – the texts impart a lot of new information, both explicit and implicit, with which readers may not be familiar, and that they

have to process. Because of their conceptual density, the reading of Science texts also requires attention to detail and accurate reading. Without precise reading, many important details in a scientific text could be overlooked by an unskilled reader. The text structure itself, which is more formal than other texts, also presents a problem for many L2 readers. The structure of the texts follows an SPSE pattern (i.e. a Situation-Problem-Solution-Evaluation pattern). Academic texts, particularly scientific texts, commonly reflect this pattern. Scientific texts also make heavy use of cause-and-effect relations and students have to understand this concept together with the semantic connectives that indicate these relations (e.g. *since, therefore*).

Davis, Lange, & Samuels (1988) investigated the effects of text structure instruction on ESL learners. The researchers specifically chose two scientific journal articles (which had been translated from English into French) on which to base their tests and their instruction. In their research they quote Widdowson (1979:51, in Davis et al. 1988) as their rationale for using a scientific expository text: "scientific enquiry constitutes its own independent, cross-linguistic secondary cultural system with its own discourse conventions". Widdowson (1979:61, ibid.) suggests further that scientific texts have certain patterns of rhetorical organisation which impose a conformity on scientific writing irrespective of the language in which they are written. The researchers found that non-native readers who had been trained on the structure of scientific articles had better recall than those readers who had not. The results of their study suggested that this type of text structure should be explicitly taught as part of a reading programme dealing with reading skills and strategies.

Ulijn & Salager-Meyer (1998) comment on the research findings of Huckin (1987) who studied the reading strategies adopted by scientists. Scientific readers tended to skim and scan in a specific way when reading research articles. For example, they first read the title, then the abstract, then the non-verbal data contained in tables etc. They then read the results sections. The actual content of the report was the last thing they read. These strategies obviously appeared to be successful, so it follows that Science students should also be taught these strategies for reading scientific texts. Reading titles and abstracts would be construed as previewing strategies which would help to activate the relevant mental schemata in order to improve comprehension and recall. Tables contain summarised, relevant data which is then elaborated in the results section. These reading strategies are skills that can be learnt in a reading intervention programme. As explained in the next chapter, the reading programme

(S*T*A*R*T) used in the current study did indeed teach such reading comprehension strategies which the intervention group (Treatment Group 2) could practise.

In scientific (and maths) texts, students encounter word problems which make linguistic, interpretative and strategic demands on students. As stated in §2.1.1, students have to understand academic, technical and common words in order to understand what they are expected to do in a word problem. A typical scientific word problem reads as follows:

> An *observer* Y, on the ground floor of a building, watches a *glass-fronted lift* moving downwards. The *magnitude* of the *acceleration* of the lift as it moves downwards is 1,5 m.s. A passenger X inside the lift drops a coin. *Relative to* observer Y, the magnitude of the acceleration of the coin is m.s…
>
> (National Senior Certificate Examination 2002- Physics HG)

The words in italics indicate the type of vocabulary that students have to interpret: *magnitude* and *acceleration* would be technical vocabulary; *relative to* would be academic vocabulary while the *glass-fronted lift* and *observer* would be common words. Any of the above words, if not understood or if not given due attention, would affect a student's ability to solve the problem.

In addition to vocabulary knowledge, word problems also demand semantic knowledge, for example, a knowledge of the relationship between words and between chunks of information. The student has to be familiar with the structure of the text as well as the conventionalised way in which word problems are presented. The student has to be able to understand the logical relations between phrases, sentences and paragraphs in order to grasp what is being presented in the text. For instance, science textbooks make frequent use of causal relations (X, *as a result*, Y) in their explanations and word problems. Consider the following statement:

> If the force of the rocket engine stays constant, the product **mass x acceleration** must also stay constant *because* **F = ma**. *Therefore* as the mass of the rocket decreases, its accleration increases.
>
> (Successful Science 10:13)

Besides the phraseology of the statement, if a student is not familiar with causal relations signalled by *because* and *therefore*, the whole statement would become meaningless.

Students also need background knowledge or a mental framework (schema) to interpret word problems. They have to learn to anticipate information and then place it in context when they are reading texts, especially expository texts. An inappropriate schema would lead to a misinterpretation of a word problem or statement.

It is for all these reasons that various researchers (Thomas 1988; Jaji 1991; Rangappa 1993; Braselton & Decker 1994) have advocated that students be specifically taught these reading skills in the Maths/Science classroom: "Pupils who learn to read a mathematics textbook with confidence will have acquired the most valuable skill a math teacher can provide" (Jaji 1991: 23). This statement is equally true for the Science student. Unfortunately, not many Maths/Science teachers understand the importance of reading in their subjects and are often trying to cope with a vast syllabus. The English teacher can help here by drawing on reading texts across the curriculum, such as was done in the current research, with a reading programme that provides reading practice across the curriculum.

2.4 Reading intervention research

The relationship between reading skill training and success in Science seems to be an important one, yet few of the research articles consulted specifically addressed this problem. However, many studies involving reading intervention programmes have been undertaken and the results are reported here. The studies use different age groups of participants, different methods/rationales and were conducted in different parts of the world, but all emphasise the point that it is reading that improves reading. In some studies, it was reported that improved reading skills as a result of intervention programmes also improved academic performance.

The reading intervention programmes that have been implemented by researchers fall into two categories, namely, extensive reading and intensive reading. 'Extensive reading' is defined by Hafiz & Tudor (1989:4) as "the reading of large amounts of material in the second language (L2) for personal pleasure and interest, and without the addition of productive tasks or follow-up language work". In contrast, 'intensive reading' involves specifically teaching students

reading comprehension strategies, thus enabling students to become more aware of their own reading processes (Dreyer 1998:18-19). Intensive reading programmes further require that students complete follow-up tasks to practise the reading strategies learnt.

Espin & Deno (1993) conducted research on the relationship between reading and academic success using Science textbook passages. However, they did not explain why they chose Science texts specifically – it appeared that Science was simply considered as an example of an academic subject. Their research was conducted using 10th graders in a midwestern rural community in USA. The students were remedial English First Language speakers. The researchers concentrated on 'read aloud' techniques in English and Science. No specific treatment was administered to the students, but they had to carry out reading tasks, and data about their academic achievement in English and Science were collected.

From the statistical analysis of the data Espin & Deno (1993) found a significant positive correlation between reading performance and academic performance (all correlations were statistically significant at $p < 0.001$). A further interesting observation emerged that is relevant to the current study: the researchers found that "reading was more strongly related to the academic success of low-level students than to that of high-level students." (Espin & Deno 1993:55). As their reading proficiency increased, the latter group of students seemed to rely on other strategies, for example study skills and motivation, to increase their academic performance.

The intervention groups (i.e. pilot intervention group and Treatment Group 2) used in the current study are post-matric and are not remedial English first language students. However, as ESL students, possibly many of this group face the same comprehension difficulties as those in the research study described above. The 'read aloud' strategy used in Espin & Deno's (1993) research seems to be a valuable tool for measuring the accuracy of word recognition skills and providing reading practice opportunities. This method was adopted in the current study together with silent reading exercises.

In another study, Elley and Manghubai (1991) investigated the effects of a 'reading for pleasure' programme on ESL Class 4 and 5 (9-11 year olds) Fijian students. There were two different intervention groups who were exposed to a 'book flood' programme, the Shared

Book group and the Sustained Silent Reading group. In the former group the teacher chose an appropriate story and presented it to the class. The students were encouraged to discuss the contents and read the easier sections with the teacher so that the reading experience became a shared one. In the latter group a definite time was set aside for silent reading (20 – 30 minutes each day) and during this time both the teacher and the students read books of their own choice from the selection provided by the researchers. The control group used the government advocated Tate Syllabus, an audio-lingual programme with prescribed graded readers which consolidated the structures and vocabulary taught in the oral lessons. Elley and Manghubai (1983) found that the exposure to reading storybooks increased their participants' reading skills and after a longer exposure (20 months) to the reading programme, the gains had spread further to other language skills. There was also a general improvement in the intervention groups in Maths and General studies, the latter consisting of Science and Social studies (Maths: $F= 13.01$, $p < 0.001$ and General Studies: $F= 17.62$, $p < 0.001$). This success was explained in terms of better communication in English between teacher and child as a result of the skills learnt during the reading programme. A further interesting finding that was that there was little difference in the results between the Shared Book group and the Sustained Silent Reading group – only in English was a significant difference in the Shared Book group's favour found: $F (1,100) = 6.51$, $p < 0.05$. The researchers' conclusion was that the teachers themselves contributed to this outcome. Many of the teachers had only limited training and were teaching in their second language (English) and therefore did not implement the Shared Book method adequately nor enthusiastically. This finding has implications for the current study which largely involved sustained silent reading, in that such silent reading can be as effective as shared experiences or group work.

Other research studies that involved extensive reading intervention programmes involving ESL students were those of Hafiz & Tudor (1989); Lai (1993) and Mason & Krashen (1997). In Hafiz & Tudor's (1989) study, ESL students (ages 10-11) of Pakistani origin were exposed to an extensive reading programme of three months in the United Kingdom. The students used graded readers and read only for pleasure in a tension-free environment. The students were not expected to perform any specific tasks on their reading material. The control groups continued with normal English lessons. Pre- and posttests in reading and writing were administered and it was found that the intervention group, while weaker at the outset, obtained consistently higher scores in the posttests. The degree of improvement of the intervention group for all the

tests administered was at a significant level of $p < 0.05$. In particular, a very marked improvement of the intervention group on the writing tests was noted. The researchers believed that contributory factors to this improvement were that through reading, students had acquired new expressive abilities in and a more positive attitude towards the target language, English. Hafiz & Tudor (1989:9) conclude their discussion by saying: " …it may well be the case that reading can provide access to new ranges of linguistic experience which can enrich learners' expressive potential beyond what may feasibly be expected from face-to-face interaction or personal experience".

In Lai's (1993) research, participants from Grades 7-9 (average age 13 years) were exposed to a four week summer reading programme in Hong Kong. As all the students were exposed to the extensive reading programme which involved sustained silent reading of graded readers, there was no control group as such. However, students with equivalent English ability in secondary school following their normal English lessons were used as a comparison group for the intervention group. The students wrote pre- and posttests in reading comprehension and their reading rate was also assessed, as was their written performance. After the pre-tests, the intervention group was divided into 3 groups, based on these results (S1, S2 and S3). In the first two groups, it was found that the summer reading course had indeed made a difference to their reading comprehension with significant gains of $t = 5.26$, $p = 0.000$ for S1 and $t = 9.55$, $p = 0.000$ for S2. The S3 group was described as a weaker, unmotivated group and so their scores did not reflect any significant gains. Similarly, the S1 and S2 groups both improved in reading rates, significant at $p < 0.0005$. For all three groups there was some improvement in certain aspects of written ability, for example spelling ($t = 2.2$, $p < 0.05$). While the weaker group, S3, did not fare as well as expected, Lai (1993) concluded that exposure to a 'reading for pleasure' intervention programme in the other two groups produced significant effects on reading comprehension, reading rate and writing skills. The researcher believed that the S3 group was less motivated towards reading and read fewer books than S1 and S2 and that these factors affected their results.

Mason & Krashen (1997) investigated the value of extensive reading in English as a foreign language (EFL) with older students at university and college level in Japan. A further consideration of this research was whether weaker students could benefit (unlike Lai's (1993) findings) from exposure to a reading programme, which also involved the use of graded

readers. Three experiments were conducted using different groups of students (the final experiment was conducted to assess the effects of extensive reading on writing in EFL as opposed to mother tongue and as this is beyond the scope of the current research, it will not be discussed). In the first experiment, weaker and unmotivated students were exposed to extensive reading for a semester. The comparison group was an intact group of second year students following the general education curriculum which included reading selections, comprehension questions, translation exercises and vocabulary and grammar exercises. Participants in the study were administered pre-and posttests. A 100-item cloze test was used for the tests. The gains made by the intervention group were significantly greater than those of the control group ($t = 2.269$, $p < 0.025$) and the researchers were also impressed by the improvement in attitude to reading shown by the intervention group. 'Reluctant' readers now became enthusiastic readers.

In the second experiment, the reliability of the effect of extensive reading was tested by duplicating the experiment with two new groups and the duration of the intervention programme was extended to a year. The control groups continued with regular classes which focused on the direct teaching of reading comprehension and intensive reading of assigned passages as well as dictionary work. Again the two intervention groups made better gains than the control groups ($t = 4.991$, $p < 0.001$ and $t = 5.035$, $p < 0.001$). In addition, qualitative information suggested that the students felt that their written skills had improved as a result of the intervention programme.

Mason & Krashen (1997) concluded that extensive reading was highly effective in all three studies and suggest that the results of their research show such reading to be a superior method to traditional approaches in the EFL classroom as well as being more popular with students. In a further study (Kim & Krashen 1997), the researchers interviewed five adult females acquiring English as an L2. The participants were native speakers of Korean and lived in the USA. None of the participants had considered extensive reading as a means of improving their English skills because in Korea they had learnt English through grammar rules and drill. The researchers recommended appropriate books and although the participants enjoyed the reading experience, they did not pursue reading any further. Nevertheless, Kim & Krashen (1997:28) still concluded that " (t)he case for free reading is strong. In addition, free reading is much more pleasant than traditional instruction."

While Hafiz & Tudor's (1989); Lai's (1993) and Mason & Krashen's (1997) studies deal with extensive 'reading for pleasure' intervention progammes, the current study adopts an intensive reading approach in an attempt to assist students in developing academic language for future tertiary education. However, what is pertinent here is that reading intervention programmes seem to be successful in improving students' reading abilities as well as motivating the students to read. Further, Mason & Krashen's (1997) participants were at post-matric level and this too is important for this current research. A final consideration is that the three studies mentioned investigated the effect of reading on writing skills. While the writing skills of the participants in the current study were not quantitatively assessed, these skills are qualitatively reported on as part of this study (from an insider perspective), as they too are vital skills at tertiary level. Spelling skills were quantitatively assessed and the results are presented in the following chapter.

In another study, Camiciottoli (2001) introduces a different aspect of extensive reading – that of reading frequency and attitudes related to extensive reading in English among Italian EFL students undertaken in the Faculty of Economics at the University of Florence. Although described by the researcher as a "non-empirical pre-experimental" study (Camiciottoli 2001: 149), the findings are of interest to the current study. With regard to frequency of reading, the data indicated that a lack of time was the most often cited reason for limited reading in English (48,1%). The students' attitudes towards the importance of reading were positive – 58% indicated that they read to increase their general literacy and vocabularies. However, the independent variable of 'years of previous study in English' correlated negatively with the variables of frequency of reading any type of English material and attitude towards reading. It appeared that the longer the students had studied English, the less inclined they were to read or to consider reading important. The researcher concluded from the students' responses that defeatism and low confidence levels in their ability to comprehend English texts had discouraged many students from reading extensively.

As a result of this study, Camiciottoli (2001) recommends that students should have access to reading materials in the classroom to encourage reading; it is also suggested that some form of an extensive reading programme should be incorporated into a curriculum so that time can be found for reading and so that discouraged students can be motivated to improve their reading skills. The current study attempted to implement these recommendations, except that in this

case the reading programme was intensive rather than extensive, and concentrated on expository Science texts in an effort to prepare the Science students for future academic study.

More closely linked to the rationale of my own research project is the research conducted by Raphan & Moser (1994). The researchers recognised the need for preparing ESL students in the USA for the academic language demands that would be placed on them at tertiary institutions. They designed a reading course that would concentrate on language skills' development in an art history course, based on CALLA – the Cognitive Academic Language Learning Approach. This approach, originally described by Chamot & O'Malley (1987, in Raphan & Moser 1994:18), aims to teach English through Maths, Science and Social Science content materials. The researchers used authentic material that was typical of the Art History course and used expository texts that could be found in any textbook or lecture on the subject. They also used magazine and newspaper articles as well as audio-and video-taped material.

Raphan & Moser (1994) incorporated explicit vocabulary training in their reading course, for instance, guessing word meaning from context. They did not test the students before or after, but they administered a survey on the course and found very positive responses to the content-based approach. As a result of their findings, they believe that a collaboaration between ESL and content faculties will "help ensure students' academic success in both language and content areas" (Raphan & Moser 1994:21).

The reading course used for the current study is a commercially available course called S*T*A*R*T (Strategies for Academic Reading and Thinking). This reading course also uses authentic expository content materials and, like the methodology of Raphan & Moser's (1994) developed course, the students are also taught to summarise, synthesise and develop their technical as well as their academic vocabulary. The S*T*A*R*T course covers reading across the curriculum, but for my research, only the Science units and Science related units were used. A more detailed description of this course is given in the following chapter.

Two South African research studies involving reading intervention programmes are also relevant to the methodology of my research, although neither used Scientific texts and differed in other aspects too, as will be discussed. A third reading intervention programme, that of Pretorius & Bohlmann (2003) for Maths students, will also be discussed.

As mentioned before, Perkins' (1991:232) research study was conducted at Unitra. In her study 'at risk' students were given pre-tests after which "individualised, self-paced instructional programmes" were designed by the researcher for the students, based on principles such as Uninterrupted, Sustained Silent Reading. This course emphasised comprehension, but vocabulary development was also considered important and thus incorporated into the course. The instructor acted as a facilitator only, while the students were responsible for their own progress. The instructor had the time to offer individualised assistance. In mid September, posttests were administered to the students to assess whether any progress had been made.

The greatest problem facing Perkins' (1991) research was that of absenteeism due to student unrest, boycotts and mass meetings. Because of this absenteeism, the researcher had to use other criteria to explain the results of her research. For example, the *t*-test was used to compare the pre- and posttest results of the high, middle and low attendance groups. Her findings were that students who attended the course regularly did improve their comprehension and vocabulary as a result of reading practice. The statistics for the high attendance group showed a significant difference at $p < 0.01$ for comprehension ($t = 3{,}497$) and $p < 0.001$ ($t = 3{,}966$) for word meaning. The mid-attendance group's results showed a statistical significance for comprehension ($t = 2.618$, $p < 0.02$) but showed no statistical significance in the word meaning tests because of absenteeism. The low attendance group showed no statistically significant gains, again because of absenteeism during student unrest. While the research showed that improvement was linked to attendance, it was found that all students, irrespective of attendance, did improve on their word meaning scores after a year of instruction.

The benefit of implementing a reading programme for 'at risk' students is clearly shown by this research, but it does not address the issue of academic achievement in other subjects, such as Science.

Dreyer (1998) researched how students' reading comprehension would improve by means of strategy instruction over a three-month period. A pre- and posttest experimental design was used with a non-equivalent control group. Four groups of students were used: Grade 12 strategy-plus-control (teacher-directed/integrated); 1st year University students who were strategy-plus-control (student-directed/self-regulated); 1st year University students majoring in

English who participated in an informed strategy instruction programme, and a blind strategy instruction group which was the control group. This latter control group was not given any instruction about the strategies that they unknowingly dealt with in the tasks they were set, hence the term 'blind strategy instruction'. 'Strategy-plus-control' instruction is described as teaching students: "… two aspects of strategy use (evaluation and transfer), as well as helping them identify the strategy, know when to use it, and practise using it" (Dreyer 1998:20). The reading strategies that were taught consisted of vocabulary training, topic sentence recognition, skimming and scanning, summarising and text-mapping.

Like Perkins (1991: 23), the results of Dreyer's (1998) study showed that "reading strategy instruction can and does make a very significant contribution in increasing the reading comprehension ability of the students." An analysis of variance was conducted to determine whether there were any statistically significant differences between the strategy-plus-control (teacher-directed); the strategy-plus-control group (student-directed); the informed strategy group and the control group. For the reading comprehension tests a result of $F = 14.83$ $p < 0.001$ was recorded. The strategy-plus-control (teacher-directed) instruction proved to be the most effective programme and the blind strategy instruction was found to be the least effective. Both these South African studies seem to indicate rather conclusively that reading programmes designed to include explicit vocabulary and reading strategy instruction are beneficial for students, particularly students who are 'at risk' at tertiary institutions. Such programmes will assist students to pursue further studies and make their long term goals more realistically attainable – "... efficient reading is an essential pre-requisite for success in today's world" (Dreyer 1998:24).

There are certain differences in the approaches of both these studies and the current research. For example, unlike Perkins'(1991) research, the intervention students (Treatment Group 2) in my study did not work through units on their own, nor did they monitor their own progress. All the students worked through the same units at the same time under my supervision. However, I was free to offer individualised assistance during their working time. Dreyer's (1998) intervention groups were taught reading strategies such as skimming and scanning and summarising. All these strategies are either included in the reading course used for the current study or were explicitly taught by me to the intervention group (Treatment Group 2). The control group (Treatment Group 1) in this research was an equivalent group as will be detailed

in Chapter Three, but they were not exposed to a reading course or explicitly/implicitly taught reading and vocabulary skills, unlike Dreyer's (1998) 'informed' or 'blind' groups.

These two research studies (Dreyer 1998 and Perkins 1991) support the tenets of the studies mentioned at the outset of this review: reading is probably the most important skill for ESL learners in academic contexts. However, the question remains: Will an improved reading ability as a result of a reading intervention programme affect academic success in a subject like Science? My research proposes to investigate this.

Pretorius & Bohlmann (2003) investigated the effects that a reading intervention programme had on the learning of Maths at Unisa. On-campus post-matric ESL subjects were exposed to the 22-week programme on a voluntary basis. The control group attended classes at the Johannesburg Learning Centre. Pre- and posttests were administered to the intervention group, but by an oversight only a pre-test was administered to the control group, thus making comparisons between the two groups problematic. The students were tested in anaphoric and semantic relations, reading comprehension, reading rate and vocabulary. They also had to complete a questionnaire on their Maths profile. Unlike this current research, the Maths study focused on both intensive and extensive reading.

In the intervention group the mean increased from 46% to 56% for the reading tests, but this mean was still low and most of the students were still deemed weak readers, many of whom would probably fail Maths. This was borne out by the results of the Mathematics Access exam in which 22 of the 33 students failed – two subsequently passed a supplementary examination.

After the intervention programme the researchers decided to examine the participants' reading skills and performance in Maths, together with their matric English results and their matric first language (African language). It was noted that the students who had failed Maths were weaker in all the above-mentioned variables, while the pass group were stronger. No significant differences were found between the groups for English, African language or Maths, but a significant difference was found between the groups for their reading scores: pre-test $p < 0.004$ and posttest $p < 0.02$. In a Pearson Product Moment correlation, it was again shown that there was a significant correlation between Maths performance and reading scores: pre-test $r = .63$, $p = 0.01$ and posttest $r = .48$, $p = 0.01$.

Pretorius & Bohlmann (2003) concluded that while reading skills did improve, it was difficult to assess the efficacy of the reading programme because of the lack of the posttest results from the control group. However, it appeared that reading did improve reading, even though the mean for the group still remained very low (56%). This figure also indicates how far behind the students are with regard to reading and how much catching up they need to do. The researchers therefore caution against 'unrealistic expectations' (Pretorius & Bohlmann 2003:234) with regard to what a reading intervention programme can achieve in a short period of time.

There seemed to be a relationship between reading skill improvement and academic performance in Maths, but again the top reading achiever in the study was classed as weak in Maths. However, the few students who passed Maths were all better readers than their peers and achieved comprehension levels above 60%. It was considered unlikely that a reading intervention programme would be beneficial enough for students studying Maths in a distance learning situation. The researchers also comment that developing reading skills also takes time and practise – there is no 'quick fix'.

However, the study clearly emphasises the necessity of good reading skills that students entering tertiary institutions need to achieve. These skills include reading rate skills, and in Pretorius & Bohlmann's (2003) research, this rate was also found to be below the expected or necessary rate (The mean rate was 136 wpm, when a rate of at least 160 wpm seemed reasonable). Students with weak reading skills are very likely to drop-out or fail if they choose to study the hard sciences at tertiary level, and the researchers conclude by suggesting that leaving such weak students "to their own devices in the hope that problems will sort themselves out amounts to an abdication of educational responsibility" (Pretorius & Bohlmann 2003:235).

While the current study does not take place in a distance learning environment, nor does it deal with Maths, the advice given and lessons learnt in the above-mentioned research are invaluable. The participants used in the current research were interviewed and tested before admission to the two Colleges and, in most cases, only medium to high achievers in Maths and Science were accepted. Their academic prowess was thus greater than the Unisa students discussed in Pretorius & Bohlmann's (2003) study, as the participants in the current study's

final Science and Maths results were, in many cases, excellent. These results will be discussed more fully in Chapter Four.

2.4.1 The duration effect

A further consideration in the current research, also mentioned by Bohlmann & Pretorius (2002), is that of the time span needed for a reading intervention programme to achieve effective results. As previously stated, the duration of the reading programme in the current research was an academic year (about 30 weeks). As will be detailed in the next chapter, a pilot study of six weeks was also undertaken prior to the intervention programme to investigate issues such as the time factor, the assessment instruments and the best method of implementing the reading programme.

Grabe's (1991:379) review article also deals with the time issue. He lists the characteristics of the fluent reader, namely, rapid, purposeful, interactive, comprehending, flexible and developing gradually: "Reading is the product of long-term effort and gradual improvement". In his review article he refers to other research on the duration of reading strategy training: Barnett (1988a, in Grabe 1991) reported on an improvement in reading comprehension after a year-long training programme, whereas the same researcher found no significant improvement after a semester of training. Dreyer's (1998) study, however, showed a statistically significant difference in reading scores after just three months, between the intervention Group 1 and the control group (cf. §2.4 above).

In their conclusion Elley & Manghubai (1983:65) discuss the phenomenon known as the 'Hawthorne effect' of novelty, whereby participants' results improve because of the novelty of new books or teaching practices. However, the authors believe that this effect wears off after a few days or weeks. The duration of training thus seems to be a key consideration in a reading intervention programme and one which this research, which has both a short and a longer intervention period, hopes to investigate as part of the main research experiment and report findings on.

2.4.2 Conclusions about reading intervention programmes

In the previous section, research on the effects of extensive or intensive reading intervention programmes on EFL and ESL students, was discussed. In all the research articles, it was argued that it was reading that improved reading and researchers set out to support this claim by implementing reading intervention programmes. Extensive reading programmes – 'reading for pleasure' – conducted with younger subjects, for example Elley & Manghubai's (1983) study, proved to be highly successful. It was also found that, over time, improved reading ability tended to spread to other areas of academic achievement. Short term intensive reading programmes, such as that of Dreyer (1998), also showed improvement in reading skills in secondary and tertiary level students. Pretorius & Bohlmann's (2003) study found a fairly strong relationship between reading skills and academic performance in Maths. In all these studies, reports of reading programmes motivating students to read more and encouraging students (and staff) to regard reading in a more serious light are mentioned. Improvements in writing skills as a result of reading intervention programmes are also mentioned. Finally, the duration of a successful reading intervention programme came under scrutiny in Grabe (1991) and Pretorius & Bohlmann (2003).

None of these studies specifically addressed the relationship between reading skills and Science, which the current research investigates, but the research that was reviewed in the previous section indicates support for and possible success of implementing a reading programme for ESL Science students. In the next section we look more closely at some issues relating to the assessment of reading skills.

2.5 Research design

In order to decide on a research design for the current quasi-experimental study, certain necessary components were identified in various other research studies. Researchers such as Elley & Manghubai (1983), Perkins (1991), Dreyer (1998) and Pretorius & Bohlmann (2003) in their reading intervention studies all implemented a reading programme, used a pre-posttest procedure and analysed the data collected. In some cases the tests were standardised tests available to the researchers, in others like Pretorius & Bohlmann (2003) the tests were developed for the purpose of the research study. Dreyer's (1998) study used a pretest/retest

method as the researcher was concerned about comparable testing. Pretorius & Bohlmann (2003) also used the same tests for both pre- and posttesting.

The current study follows the same procedures as those of the above-mentioned researchers. Pre-tests were administered; a reading programme was implemented; a posttest followed and data were collected and analysed. A test/retest method was adopted in that the same reading tests were used in the pre- and posttests and these test results were compared.

2.5.1 Reading assessment

For the general principles of testing and the explanations of testing terms, for example reliability and validity, the book by Hughes (1996) on testing procedures was very helpful. A test is considered *reliable* if it measures a subject's response consistently. Human nature being what it is, it is most unlikely that a subject will score exactly the same on a test taken one day or the next. However, there are certain procedures one can adopt to increase the reliability of the test. Hughes (1989:52) suggests that pretesting is one such procedure. By pretesting a group similar to the target group, any problems, for example the wording of instructions, can be ironed out. In the current study a pilot study was undertaken for precisely this reason. As a result of this pilot study, the reading tests were modified and amended before they were administered to the target groups. The alpha (Cronbach) reliability test was applied to each component of the pre- and posttests for the control and intervention groups to measure their reliability. The reliability co-efficients for the tests are presented in Chapter Four.

A test has *content validity* if it includes enough samples of what the test is concerned with. It has *construct validity* if it tests what it is meant to test. For example, many so-called reading tests actually test general language proficiency and vocabulary and not necessarily a student's ability to read. In order to establish the validity of the tests used in the current study, the tests were adapted from research pertaining to effective techniques for testing reading. (The rest of this chapter deals with the research into reading testing procedures and my adaptation of these for the purposes of the current study). In addition, my colleague (with a degree in Linguistics) discussed the tests with me before they were administered and rechecked the tests as the students wrote them. In the marking of the tests, grammar and spelling were not taken into account at all. In this way only reading skills were assessed.

Hughes (1989:Chapter 11) suggests that in testing reading ability certain skills, for example, scanning text to locate specific information need to be included in the test. He terms these 'macro-skills' (Hughes 1989:116-117). In addition, 'micro-skills' (ibid.), such as guessing from context, also need to be tested. Possible techniques for testing reading are suggested to ensure validity, such as multiple choice items and information transfer. In the former technique students indicate successful reading by choosing one alternative from a selection. This technique has a number of variations, for example, true/false items. Information transfer is also an effective testing technique as it minimises the demands made on the writing abilities of students. Information is presented in illustrations, maps, etc. and students transfer the information to a table or complete a cloze passage. These techniques were used in the tests that were developed for the current study. Hughes (1989:Chapter 11) also proposes guidelines for testing procedures that one needs to know before embarking on administering tests, such as preparation and accurate timing.

The reading course that was used, S*T*A*R*T, had reading comprehension texts and exercises that I was able to adapt for the two reading comprehension tests used in the pre- and posttests. Multiple choice questions, true/false items and cloze were some of the exercises used in the course units and these activities were adopted in the reading tests.

Davis, Lange & Samuels (1988) comment on the use of scrambling sentences as a device for testing readers' understanding of text structure. Readers' are required to attend to textual clues to construct meaning and to recognise the underlying semantic relations between sentences which are not always specifically signalled by the use of conjunctives. This testing technique taps into a reader's ability to contruct meaning from reading texts and so it was also used in the reading tests developed for the current study.

The other components of the reading tests that were developed (detailed in the next chapter) were based on information received about a reading course developed at Unisa for Maths students in 2000 by the Departments of Mathematics and Linguistics. The researchers, Bohlmann & Pretorius (2002), published a research article on the various testing procedures that were adopted for this intervention programme. For example, the principle of assessing reading comprehension by testing anaphoric resolution, was adapted from the Maths content to a Science-related context for the purposes of the current research.

In assessing anaphoric resolution, the subjects have to be able to identify repeated references in a text to an item that was mentioned before (i.e. the antecedent). The references could be by a repetition of the same linguistic item (e.g. a noun) or by using another equivalent item, for example, a pronoun, to refer to the antecedent. It is claimed that skilled readers are adept at successful anaphoric resolution (Webber 1980, in Bohlmann & Pretorius 2002). It was therefore deemed necessary to include such a test for reading skills in this research.

A skilled reader also has to understand the text as a coherent and cohesive whole, and semantic relations are vital in this process. It therefore makes sense to test a student's sense of cohesion in reading by testing aspects of text-semantic relations, for example causal and contrastive relations. Research findings suggest that a knowledge of these relations again separates the skilled from the less skilled readers (Geva & Ryan 1985, in Bohlmann & Pretorius 2002). A further reason for testing this aspect of text comprehension is that semantic relations are also a characteristic feature of scientific discourse, as detailed in §2.3.

In Cox, Shanahan & Sulzby's (1990) study on good and poor readers' use of cohesion in writing, the researchers also found that a knowledge of cohesion ('cohesive harmony') distinguished the good readers from the poor readers (and writers). Although the researchers were using third and fifth grade subjects, not older students, their findings are significant and applicable to older subjects. The good readers used more cohesive harmony than the poor readers. One of their conclusions was that a knowledge of cohesion was implicated in the quality of both reading comprehension and writing skill "regardless of the grade level of the child or differences in genre" (Cox, Shanahan & Sulzby 1990:59).

Reading rate assessment is also considered an important component of reading skill assessment. Both Bohlmann & Pretorius' (2002) and Lai's (1993) studies provided information on how best to construct and administer such a test, as well as guidelines for interpreting the results.

Nation's (1990) vocabulary test was consulted before a vocabulary test was constructed for the participants of the current research. The words were all chosen from a current Science textbook available for Grade 12, that is, *Successful Science 10* (Broster & James 1989). The latter textbook also provided the words used in the spelling test that was administered. The

reading questionnaire dealing with habits and linguistic background was partly developed from Ivey and Broaddus'(2001) questionnaire. I had drawn up a linguistic background questionnaire in 1998 (as a result of my studies in Applied Linguistics) and had been administering this questionnaire as a matter of course each year to the students at our College. To this was added the reading habit questionnaire (Ivey & Broaddus: 2001) for the purposes of the current research.

2.6 Conclusion

This chapter has dealt with the literature pertaining to the current study. The relationship between reading, vocabulary, and academic success was discussed. Admission testing together with reading and its relationship to an academic subject like Science was reviewed. Research studies pertaining to reading intervention programmes and their implementation were presented. Issues in research methodology, such as research designs and techniques for the assessment of reading ability and for the statistical analysis of data were also presented.

The research literature reviewed has, on the whole, provided support for the introduction of a reading intervention programme coupled with vocabulary strategy training in an attempt to assist ESL students in academic achievement. Studies with similar aims provided ideas for the design and implementation of the current research as well as for the statistical analysis of the data collected. The research studies also highlighted problem areas and possible solutions to the problems in the research context of the current study.

None of the sources consulted specifically dealt with a possible relationship between improved reading ability and academic success in Science. This was a research 'gap' I first noticed when deciding on a research topic. Hopefully, the findings of the current study will contribute to a better understanding of this relationship.

CHAPTER THREE

RESEARCH FRAMEWORK AND PROCEDURES

3.0 Introduction

This chapter describes the research design, the research procedures adopted and the analytical framework used to assess the data in this study.

3.1 Research design

This study is predominantly quantitative and experimental. It comprised one control group and one intervention group in the pilot study and in the main study, a Treatment Group 1 and a Treatment Group 2 (cf. §3.8). Treatment Group 1 functioned as the control group and Treatment Group 2 as the intervention group, but there was no strict comparison between the two groups in terms of the treatments. Treatment Group 1 was merely used as a yardstick by which to guage the performance of the real intervention group, Treatment Group 2. An intervention treatment was implemented for Treatment Group 2 and pre- and posttests were administered to both groups. The intervention treatment is the independent variable and the reading and Science scores are the dependent variables. Data have been collected and statistically analysed in an effort to test the hypotheses stated earlier, in §1.8. The study is therefore deductive and hypothesis-driven. It includes elements of a descriptive nature as well, as provided by information from questionnaires which, for example, describe the students' reading habits. In addition, as I administered the intervention treatment (the intensive reading course) to the intervention groups (pilot intervention group and Treatment Group 2), there is information from my own perspective – the insider perspective.

The approach of this study is analytical in that it focuses on specific aspects of language proficiency, namely, reading comprehension together with vocabulary skills.

According to Nunan's (1992:41) definition of research designs, this investigation is considered to be quasi-experimental because the subjects were not randomly assigned to control (Treatment Group 1) or intervention groups (Treatment Group 2) for the purposes of the

investigation; the groups already existed, that is, they were intact groups, before the implementation of the reading intervention programme. As a quasi-experiment, the investigation was divided into two parts (as mentioned before), namely, a pilot study of six weeks conducted in August/September 2002 and the main longitudinal study of eight months (30 weeks) conducted in 2003.

In the sections that follow, the participants, procedures and materials for the research study will be outlined in general, and then more specifically, for the pilot study and the main study. The results of the pilot study will also be discussed in this chapter. Because the pilot study was used to test the assessment materials and the procedures for implementing the reading intervention programme, it was felt that the pilot results should rather be included in this methodology chapter.

3.2 Statistical analysis of data

Many of the research studies mentioned in the review chapter were quantitative and experimental and so deal with the analysis of quantitative data. The nature of the current study's research design requires certain statistical procedures. The Shapiro-Wilk test showed that normality could be assumed between the two groups and so parametric tests could be used with confidence. In a quasi-experiment pre- posttest design comparing the results of two groups, *t*-tests are used. Perkins (1991), among others, presents *t*-test results. The current research used the *t*-test procedure to assess if there was a significant difference in reading abilities of the intervention and control groups as reflected in their pre- and posttest performance in the pilot study. The *t*-test was also used to test for significant differences within the groups with regard to their improvements in English and reading abilities. In the main study, Levene's test of homogeneity was applied to the results to determine pretest differences beween groups (to be reported on in Chapter Four); *t*-tests were also used to assess the differences in performance of Treatment Group 1 and Treatment Group 2 in the pre- and posttests, as well as their performance in English and reading.

Patowski's (1991) and Dreyer's (1998) research refers to the statistical procedure, ANOVA (Analysis of Variance), which is a procedure used to compare more than two groups or variables. In Pretorius & Bohlmann's (2002) research, the ANOVA was used to compare the

overall reading scores of four groups of students with different reading abilities (reading groups) with their results in the final Science examination (three academic groups). In the current study the ANOVA technique was also used to compare the effects of a reading programme (as reflected in the students' posttest reading results) on students of different reading abilities and their subsequent academic performance in Science in the final National Certificate Science examination. Finally, the Pearson Product Moment correlation was used in the current study. This correlation technique examines the relationship between two or more variables and this technique was used as a means of establishing a possible relationship between the reading scores and the Science/English scores (Patkowski 1991; Espin & Deno 1993; Mason & Krashen 1997) in the current study.

3.3 Participants

The participants were Black male and female students from previously disadvantaged educational and economic backgrounds. They were post-matric students of about 18-19 years old who came from urban and rural schools throughout South Africa. English was their second (L2) or even third (L3) language, and many of the students also spoke Afrikaans, but their first languages (L1) were any of the other nine official languages of South Africa. The students thus represented a sample of the population that any South African tertiary institution might find enrolling for academic courses for the first time.

Many of the students were products of the ex-DET system where they began instruction in all subjects in English in Grade 5. Some attended English schools from Grade 1. All wrote the National Senior Certificate Matriculation Examination but many wrote Science and Maths on Standard Grade. Most of the students wrote English Second Language on the Higher Grade. In the bridging year at our College, the students all re-write Maths and Science on the Higher Grade and they write internal English examinations in June and September.

All the students who participated in this research study in both the pilot study (2002) and the main study (2003) were apprised of the aims and procedures of the study and no-one participated in the programme against his or her will.

As stated previously in §1.5.1, before the students start at the College, they write admission tests and are interviewed. If accepted, they are divided into classes of roughly 22 students each. Each class contains low, middle and high ability students in Maths, Science and English language proficiency. The classes are thus not streamed in any way, but reflect a range of ability.

There is no official syllabus for the English Communication course at the College. My colleagues and I have agreed on a broad, flexible approach which addresses the language needs of the students as they arise. The 'syllabus' covers speaking, listening, reading and writing skills in English. The reading is of narrative texts, newspapers and magazines for pleasure only. The students are taught to use dictionaries, but further vocabulary strategy training does not occur. Vocabulary learning is rather addressed through 'fun' activities like word games, for example, Scrabble, crosswords and blockwords. The students are required to write formal letters, paragraphs, reports and summaries. They complete reading comprehension tasks and they are also taught listening comprehension skills. They participate in debates and public speaking programmes. In short, the 'syllabus' covers many aspects of language learning in general, but none specifically.

The students re-do the matriculation Science (and Maths) syllabus. They write internal preliminaries in September and the final National Senior Certificate Science and Maths examinations on the Higher Grade at the end of the year (October/November).

Because of ethical objections raised by the Management of our College, I was forced to adopt slightly different procedures for the pilot study and the main study with regard to participants and procedures. This information will be provided in the description of the procedures for the two phases (cf. §3.6 and §3.8).

3.4 Assessment materials

The assessment materials used for this research comprised reading, vocabulary and spelling tests, and a questionnaire on language backgrounds and reading habits. Reading rates were also assessed. Samples of the tests are presented in the Appendix. Information regarding Science and English scores throughout 2002 and 2003 was also used.

Similar to Dreyer's (1998) research assessment method discussed in §2.4, a test/retest method was adopted to ensure that the tests were equivalent. This approach best suited the current research study because I designed my own tests with help and suggestions from various sources, instead of using standardised tests that are so costly and do not seem to be readily available in South Africa. Some of the reading tests available in this country also seem to test language proficiency. While these two concepts are indeed related they are, as Bohlmann & Pretorius (2002: 196) point out, "conceptually and cognitively uniquely specific skills that develop in distinct ways".

Because the tests used were self-designed, I decided that I would rather retest the students using the same tests developed for the current study to establish equivalency, than use any other tests. The students did not see the tests between testing times, nor were the tests discussed with them in any way. The time lapse between the pre- and posttests was long enough to cancel any memory effects. This was confirmed later by my questioning the students, many of whom stated that they had little recollection of the pre-tests. In the control group and Treatment Group 1, the tests were administered by my colleagues, following my instructions. I marked all the tests and collated all the results. The following assessment measures were used for the purpose of this research:

3.4.1 Reading rate

An expository text of 762 words about vacuums entitled 'Harnessing the power of nothing' was used to assess reading rate (cf. Appendix A). In this test, the participants were first required to read the first page of the text (256 words) for a minute and then circle the word they had reached at that point in time. The number of words read per minute was calculated. The students then read the rest of this page in their own time. When finished, they turned to the second page of the text and read this, noting their starting and finishing times. This gave an indication of the time taken to read the remaining passage of 506 words. By dividing the number of words (506) by the time taken to read the second passage, a further score of words per minute was calculated. These two sets of scores of words per minute were later added together and averaged out to give an indication of number of words read per minute of the whole reading passage.

The students were then asked to answer a multiple choice comprehension test comprising ten questions on the text after it had been handed in, to check the accuracy of their reading. This was given a percentage score. While this is not an ideal method of checking comprehension as it relies on memory recall, it was a way of preventing the students from skimming the words in the text as fast as they could. Lai (1993) used a similar means of assessment of reading rate in a summer reading course detailed in §2.4 and found it to be a reliable means of assessment. Lai (1993) excluded the scores of students who had scored less than 75% on the comprehension test in the results. I did not exclude such students, but rather used 70% as a cut-off point for what I considered to be a fair rate of reading accuracy. This is further explained in the next chapter which details the findings of this current research.

3.4.2 Reading comprehension

Two reading comprehension passages based on Science-related expository texts were adapted from the S*T*A*R*T reading course for use in this research (cf. Appendix B). Text 2 provided information on Space Exploration and Text 3 dealt with The Energy Crisis. Each test contained multiple choice or true/false questions. Of the 11 questions in total, only two were literal. The students were further required to re-order scrambled sentences, complete tables and extrapolate information from diagrams.

3.4.3 Anaphoric resolution

An anaphoric resolution test consisting of ten items was developed, using examples from the Grade 12 Science textbook and the reading course workbook (cf. Appendix C). Each anaphoric item occurred in a paragraph in which certain pronouns or determiners (the anaphoric item) were printed in italics. The students had to identify the nouns/noun phrases (referents) to which these anaphoric devices referred and draw a line with an arrow to show the backwards link between the anaphoric item and the prior referent.

3.4.4 Semantic relations

A semantic relations test consisting of three sections was developed (cf. Appendix D). The semantic relations selected were those most commonly found in scientific texts (discussed in

§2.3), for example, causal and exemplification relations. Section A required the students to insert omitted sentences (six items) into paragraphs taken from the above-mentioned sources which tested their understanding of semantic relations.

Semantic relations at their simplest consist of a two-pair relation, for example, a statement and an example. In this section one component of the pair was omitted and the student had to understand the contents of the paragraph in order to match the missing part with the right component and fit it into the paragraph. Section B (four items) required the students to order scrambled sentences in a paragraph. This assesses the students' understanding of contextual clues given in the sentences and the underlying semantic relations between sentence propositions, for example, cause and effect. Section C was a modified cloze test that required the insertion of conjunctions into paragraphs thus assessing the students' understanding of causal (*therefore*); conditional (*if*); exemplification (*for example*) and contrastive (*but*) relations which are the semantic relations most frequently found in the prescribed Science textbooks and which need to be understood in order for the paragraph to make sense to the reader. This section consisted of nine items.

3.4.5 Vocabulary

A vocabulary test of 60 items was drawn up (cf. Appendix E). This tested knowledge of the three categories of words, namely high frequency, (*category, sequence*), academic, (e.g. *clarify, differentiate*) and technical, (e.g. *mass, sonic*) words. The students were also asked to write eight definitions of general knowledge words taken from questions and examples in their textbooks, (e.g. *scaffold, roller coaster*).

3.4.6 Spelling

A spelling test of 50 items testing high frequency (*require*), academic (*analyse*) and technical (*momentum*) words was used to test the students' spelling skills (cf. Appendix F).

3.4.7 Language profile

A questionnaire on the students' linguistic backgrounds and their reading habits was completed by the participants (cf. Appendix G). Questions regarding their first languages, schools attended and years spent studying other subjects in English were asked. The section on reading habits was adapted from Ivey and Broadus's (2001) appendix. Students were asked, for example, how often they read and what their reading preferences were.

3.4.8 Scores

The Science scores from examinations in June, September and the National Senior Certificate final results for 2002 and 2003 were collected.

The English internal examination results for June and September 2002 and 2003 were also collected.

All in all, a fairly comprehensive set of information was collected for the purposes of this research:

- reading comprehension pre-and posttest scores for the pilot study (2002) and for the longitudinal study (2003)
- vocabulary, spelling and reading rate scores for the longitudinal study (2003)
- questionnaires regarding language backgrounds for both studies and questionnaires regarding reading habits for the longitudinal study (2003)
- Science scores for June, September and the National Senior Certificate final examinations for 2002 and 2003
- English scores from June and September internal examinations (2002 and 2003)
- verbal reports from colleagues regarding any academic progress exhibited by the students in both studies
- my own observations – the insider perspective.

These data were statistically analysed using the SPSS (Statistical Package for the Social Sciences) computer programme. Descriptive statistical procedures were used, for example,

mean scores and standard deviations. Statistical procedures for inferential statistics were also used: the *t*-test, the ANOVA factorial analysis and the Pearson Product Moment correlation were applied to the students' scores to explore relationships and trends in these scores in order to interpret the results obtained. In all cases, probability levels were set at 95%, that is, p 0.05. The pilot study results are presented in this chapter, while those of the main study are presented in Chapter Four.

3.5 Intervention materials

A reading programme developed by the Centre for Cognitive Development at Vista University called S*T*A*R*T (Strategies for Academic Reading and Thinking) was used for the intervention groups of 2002 and 2003. This course, which is commercially available in workbook form, covers reading across the curriculum. In this way, readers are exposed to a wide range of low frequency and academic words that typically occur in the discourses of the human, social and natural sciences. Five selected topics from each of the following subjects: English, Science, History, Geography, Biology, Ecology, Economics and Mathematics, are used in four graded reading levels. The course thus consists of four workbooks with 40 units in each. Each unit includes a text on a particular topic and the subsequent tasks are based on this text. Reading strategies are taught in each unit. The acronym **PASSSS** is used in each unit. This stands for **P**urpose, **A**ctivate background knowledge, **S**urvey (skimming and scanning), **S**tudy read, **S**ummarise and **S**ynthesise. The students are required to complete a variety of tasks, for example, multiple choice, ordering items and tabulating information. Levels 2 and 3 were used in the research as the reading standard of these levels was appropriate for the reading abilities of the students. Only expository texts from the Science sections and related texts (e.g. from Maths) were used by the intervention group and Treatment Group 2. Group work with the teacher as facilitator, or individual study can be used in the course. The units are 'user-friendly' in that any teacher can use them, even if not qualified in that particular subject area. I was thus able to work on the Science units even though I have a limited knowledge of the subject.

3.6 Procedures

As stated, this research was divided into two phases, namely, the pilot study undertaken in August/September 2002, and the main study begun in February 2003 and completed in September 2003. The pilot study was undertaken as a trial run for the main study the following year. The assessment materials had to be tested on the participants and modified, revised and/or corrected, if necessary. The best method of implementing the reading programme had to be decided upon. In addition, the time needed for the administration of the different assessment materials and for the completion of the various units of the reading programme had to be trialled. Any other problems regarding College activities and examination demands had to be assessed during the pilot study so that they could be addressed in the main study. This information, accumulated over the six weeks of the pilot study, is discussed in the following section.

3.7 The Pilot study

The pilot study was carried out during the third term (August/September) of 2002. One control group and one intervention group were used from within our College. I taught the intervention group and my colleague, the control group. Both groups had the same Science teacher.

3.7.1 Participants

The participants were Black male and female students with English as a second language. The intervention group contained 16 students, of whom four were female. The control group consisted of 16 students, five female students and 11 male students. The students came from throughout South Africa, from urban and rural areas alike. All came from previously disadvantaged academic and economic backgrounds.

3.7.2 Assessment materials

The students wrote five reading tests in total:

(i) Three comprehension tests on Science-related expository texts adapted from the S*T*A*R*T programme.

(ii) The anaphoric resolution test.

(iii) The semantic relations test.

In addition, they completed the questionnaire which at this stage only required information on language background. The Science scores from June and September were collected for both groups, as were the English scores. The final National Senior Certificate Science results were collected in January 2003.

3.7.3 Procedures

Both intervention and control groups wrote the tests and completed the questionnaire in early August 2003. From their responses to these pre-tests I found it necessary to refine the tests. The reasons for this are detailed in §3.7.4.

The intervention group then studied two of the Science units of the reading programme S*T*A*R*T Level 2 and two Science units from Level 3 for two hours a week over a six-week period. An example of a Science unit has been included in the Appendix (cf. Appendix H). The students worked on their own for some units and completed these units for homework. We then marked their work in class. In two units, the students worked in pairs and completed the units. The final unit was read in class and we worked through the answers orally.

Earlier in the year, the students had been taught vocabulary skills, that is, the use of dictionaries, guessing from context, semantic relations and morphological skills. During the reading course these skills were practised again. In the remaining two hours per week, the students covered the same syllabus as the control group.

The control group continued with the English syllabus, which in this term entailed the study of advertising techniques and the writing of reports for four hours a week. Both groups thus received equal amounts of English instruction time.

Both groups then rewrote the revised tests after eight weeks. In addition, the intervention group was asked to write a paragraph on whether they had enjoyed the reading course and on whether they preferred working on their own, on their own with teacher input, or in groups (cf. Appendix I).

3.7.4 Revision of test materials

After administering and marking the reading pretests for the intervention group, some problems were identified which resulted in modifications to certain aspects of the tests. The control group wrote the tests one week later than the intervention group and so they wrote the revised tests – the intervention group only saw the revised tests in the posttest administration.
It appeared that the first comprehension test was too simple for post-matric level. The text itself was too easy and too short. There were not enough inferential questions and the tabulation question required only that the students copy information directly from the text. The marks for this test were therefore unrealistically high and this test was scrapped altogether. The students did not rewrite it as a posttest and the pre-test results were not included as data for analysis.

In the second comprehension test, one section requiring the students to complete a table had to be reworded for the posttest as some of them misunderstood what they had to do.

The time allotment for the semantic relations test was originally 40 minutes, but very few of the students finished in this time and so the time was extended to 50 minutes in the posttest.

Finally, a few of the students scored badly in the anaphoric resolution pre-test. One possible reason for this was that they had not understood the instructions, so the instructions for the posttest were reworded. My colleague and I also explained the instructions at length for the posttest, using the blackboard and examples on the overhead projector. There was an improvement in the students' scores in the posttest.

3.7.5 Results

The hypotheses for the main study of this current research are presented in §1.8. The pilot study was a trial run for the main study, so the same hypotheses apply to the pilot study even though the time span for the two studies is different. The hypotheses for the pilot study could thus be formulated as follows:

H 1: *After a six-week reading intervention programme with an intervention group, there will be a significant difference in the reading abilities of the intervention and control groups respectively, as reflected in the pre- and posttest reading scores.*

H 2: *There will be a significant relationship between academic performance in Science and reading ability.*

The pilot study was used as a trial run for the main study that took place in 2003. As explained, the pre-and posttests were not equivalent as I had to revise them. Further, some of the revisions were completed before the control group wrote the tests. I therefore did not run a complete statistical analysis on the results nor have I presented all the results. The main trends to emerge from the pilot study are presented in Table 3.1. The results that are tabulated are the following:

- A mean reading comprehension score is expressed as a percentage, calculated by adding the scores for each component of the reading tests and averaging the scores for the pre- and posttests. Standard deviation scores were also calculated for the control and the intervention group for the pre- and posttests.
- The Science scores for June, September and the finals, as well as the English scores for June and September were similarly calculated and are presented as percentages.

These statistics have been tabulated and are reflected in Table 3.1 on the following page:

Table 3.1 Reading scores, English and Science scores for 2003. The SD is given in brackets

		Control n=13	Interv. n=16
Reading	*Pretest*	**59.2 (10)**	**61.6 (10.1)**
	Posttest	**66.5 (10)**	**62.2 (10.1)**
	Gains	**7.3**	**0.6**
English	*June*	**59.5 (9.59)**	**53.9 (11)**
	September	**55 (12)**	**52.3 (6.99)**
	Gains	**-4.5**	**-1.6**
Science	*June*	**58.8 (8)**	**59.9 (7.85)**
	September	**56.9 (13)**	**54.3 (8.17)**
	Gains	**-1.9**	**-5.6**
	Finals	**60.5 (10)**	**60 (12.2)**
	Gains (Sept. – Fin.)	**3.6**	**5.7**

In order to test these hypotheses in the pilot study, a two-sided, two-sample independent *t*- test was used to compare the means of the scores achieved in the two groups. In the comparison of the pre-test and posttest reading scores of the two groups, a null hypothesis was accepted, thus indicating that the reading abilities of the two groups had not changed significantly after the six week intervention ($t = 0.26$, df 27, $p < 0.10$).

In a further *t*-test, the Science scores for June and the finals of the intervention group were compared. There was no statistically significant difference in the scores ($t = 0.98$, df 30, $p < 0.1$) However, using the Pearson Product Moment correlation to examine a possible relationship between reading scores and Science results, it was found that in September/October there was a significant (albeit low) correlation between the reading scores of the intervention group and their performance in the final Science examination. There was a negative correlation between reading and Science in the control group. The statistics are presented on the following page in Table 3.2.

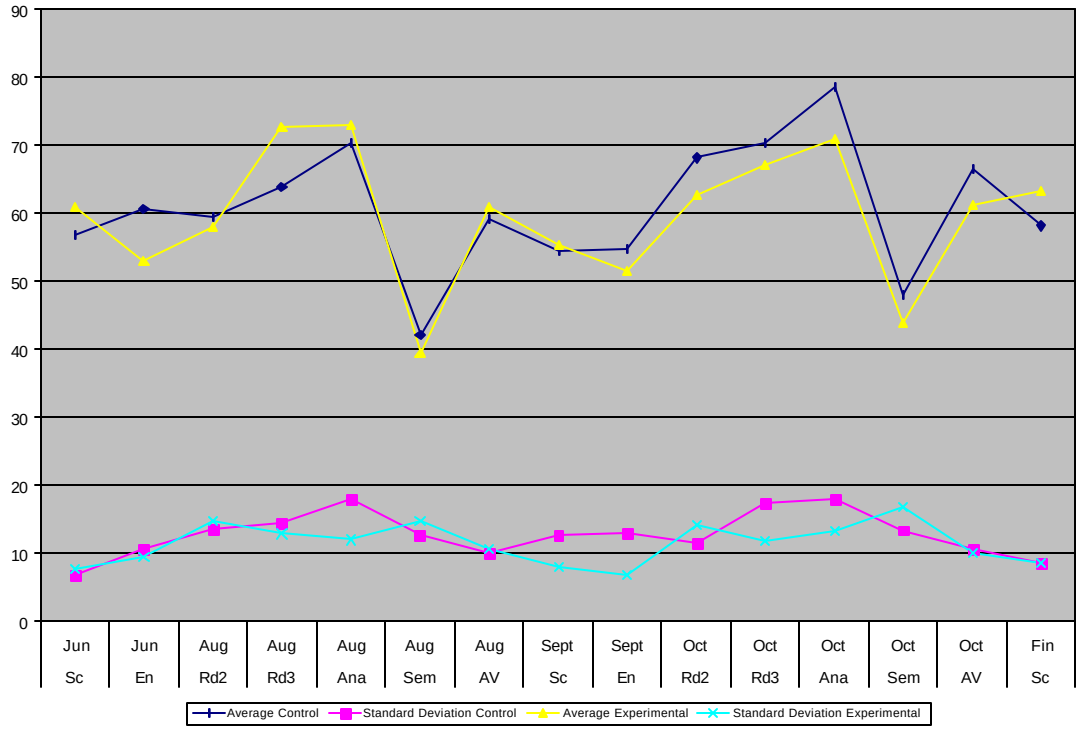
Table 3.2 Correlation results (*r)* between the posttest reading averages and the final Science results for the control and intervention groups.

	Control n = 13	**Intervention n = 16**
	Science	**Science**
Reading	***r* = -0.25 (*p* < 0.05)**	***r* = 0.39* (*p* < 0.05)**

As can be seen from Table 3.2, there is a negative correlation between the reading tests and the final Science results in the control group, indicating that there was no perceivable relationship between the two sets of results, while the intervention group shows a positive albeit modest correlation between the reading posttests and the final Science results (§4.3.1). Although not included in this table, in both groups it was interesting to note that there was a very low correlation between the English results and the Science results: $r = 0.19$, $p < 0.05$ (control group) and $r = 0.14$, $p < 0.05$ (intervention group). Also not included in this table was the correlation between the posttest reading results and the final English results. The English score reflects a wider notion of English proficiency, but the reading skills taught to the students were tested during the exams and contributed to this score. In the control group the correlation between English and reading was moderate ($r = 0.47$, $p < 0.05$) and in the intervention group the correlation was slightly lower ($r = 0.38$, $p< 0.05$). Both correlations were nevertheless significant, thus indicating a relationship between reading skills and the English score.

To further explore any possible relationship between reading ability, language proficiency (as reflected in the English scores) and academic performance in Science, the graph presented on the following page in Figure 3.3 plots the mean for the reading, English and Science tests (and the standard deviations) of the two groups throughout the year. (In this graph, scores of two outliers in each group have been removed, for example one student failed Science with a G symbol in the intervention group – during the year he had achieved high D symbols. His result was therefore not anticipated and unusual). The separate reading, English and Science scores for the pretests (June and August) and posttests (September-October) are represented along the Y axis of the graph.

Figure 3.3 Graph showing the results for all the tests and the standard deviations for control and intervention groups



The graph indicates that both groups performed fairly similarly. The intervention group maintained their English scores from June until September, while the control group had a drop in average marks in English for no apparent reason as both groups wrote the same internal examination in September. While the intervention group began with a small advantage in Science scores in June, they achieved only marginally more in September. However, in the final Science exam their scores were once again higher than those of the control group. The standard deviation scores which are virtually equivalent also point to the fact that the control group and the intervention group were drawn from equivalent academic groups of the population.

With reference to the inequivalent tests in this pilot study (§3.7.4), one can clearly see the difference in the results of the control group's anaphoric pre-and posttest on the graph plotting, after the re-wording of the instructions for the test. Familiarity with this task no doubt also played a role in this result.

The questionnaire on the language background of the students revealed that all were ESL speakers. Their first languages were isiZulu, Sesotho, Setswana, Sesotho sa Leboa and Tshivenda. Only one student spoke isiXhosa. All the students could either speak, read and write at least one other language, besides English, that is, they were multilingual. Most of the students (80%) began learning English from their teachers when they started Primary School. The rest were taught by their parents in their pre-school years. Most of the students (90%) began studying other subjects in English from Grade 5 – in the ex-DET system of education. The remaining 10% went to ex-Model C schools and studied all subjects in English (except their L1) from Grade 1. All the students continued studying their first languages to the end of Grade 12 but no other subjects were studied in their first languages.

The intervention group's paragraph on their opinion of the reading course indicated that they had all enjoyed the reading course and that they believed that their vocabulary and general knowledge had improved. Most of the students stated their preference for working alone, not in groups, and for silent reading but with teacher input.

3.7.6 Discussion of the results

It was expected that both the Science and the reading test results of the control and the intervention groups would show an improvement with practice, experience and highly qualified teachers over the six weeks, and this was confirmed by the results in Table 3.1**.** However, contrary to expectation, the control group showed greater improvement than the intervention group in their posttest reading scores but, as explained before, their better performance in the anaphoric resolution test contributed to this result. It would appear, though, that in the short period available for the pilot test, the reading programme had not yet made an impact on the intervention group, hence their moderate performance in the posttests.

These findings also support Elley & Manghubai's (1983) argument that the 'Hawthorne effect' of novelty wears off after a few days or weeks (cf. §2.4.1). The intervention group did not appear to be affected by the novelty of the reading programme as their results, compared to those of the control group, indicated.

The Pearson Product Moment correlation findings were encouraging, as there was no expectation of any potential link between the results of the reading tests and the final Science results after such a short period of time.

While the sample sizes were small for this pilot study (29 participants), the results were encouraging. They established a potential link between performance in English, the contribution of the intensive reading programme and the resultant effect on Science. A larger study using more students was indicated after analysing the pilot study results and so the main study in 2003 using 86 students became the focus of attention in this quasi-experimental study.

Also on the positive side, the pilot study indicated how the implementation of the reading course in the main study could be improved. From their paragraphs, the feedback from the intervention group showed clearly that the students preferred working alone, but with teacher input. Group work was not viewed as successful or enjoyable. As group work is strongly emphasised in the current outcomes-based educational approach in South Africa, this was an interesting observation from students who were taught within this system.

As a result of this pilot study, certain concerns were also noted which, as far as possible, had to be addressed for the main study in 2003.

The greatest setback in the pilot study was the time factor. Certain tests, for example, the vocabulary tests and the reading rate tests, were not administered as posttests as a result of lack of time. Normal College activities, for example, sponsor day presentations and sponsors' visits, interfered with lessons and testing times. Time was also limited as we had to finish English classes earlier than anticipated in 2002 because the National Senior Certificate examinations began earlier than in previous years.

With regard to the participants, two students dropped out of the control group which altered the averages of this group in the pre- and posttests. Students also missed tests because they were absent or attending interviews with sponsors. Many students were tired by the end of the year and somewhat demotivated to rewrite the reading tests – their poorer results, in some cases, seemed to indicate this. In the main study (2003) the posttests were written after the third term vacation, so that the students were more rested.

As explained in §3.7.4, the reading tests were also revised. This meant that the pre- and posttests for the reading intervention programme were not equivalent and the data from these tests were not accurate enough to be thoroughly analysed.

After the findings of the pilot study, certain amendments to the reading tests were made for the main study, which began in February 2003 with a new set of students and some unexpected difficulties, not present during the pilot study.

3.8 The Main study

As the year and the main study began, a member of the College Management (because of concerns about sponsorship), felt that it was unethical to have only one class receiving the intervention treatment and decided that all the classes should be treated equally. While this decision meant that there were 66 students that could be used for the main study, it also meant that there was now no control group. Our College has allied 'sister' or satellite Colleges and the nearest one in terms of distance proved to be supportive and amenable to aiding this research by providing a 'control' group. (Letters of permission, from both colleges, to conduct the current research are included in Appendix J). This group is sponsored by a mining company and their classrooms and living quarters are on the company premises. While the procedures at the sister College were often different from ours, the pool of students was equivalent, as was the bridging course designed for the students. This change of control group to one in another College did not affect the overall design of the study, but it affected procedures for the main study and the control that could be exercised over both groups. It was thus deemed advisable to use this class from the sister College merely as a yardstick to guage the performance of our 66 students and no strict comparison was implemented between the two groups. For this reason the groups were renamed Treatment Group 1 ('control' group) and Treatment Group 2 ('intervention' group). The study continued much as planned, with one further setback: only one set of reading programme books (S*T*A*R*T) had been ordered in anticipation of only having one intervention class using them and the College budget did not extend to ordering more books at this late stage. Students in Treatment Group 2 thus had to share books and were thus unable to finish units as homework, which considerably slowed down the implementation of the reading programme in that fewer units were completed than initially anticipated.

3.8.1 Participants

The participants of the main study were much the same as for the pilot study. They were ESL male and female students from throughout South Africa, undergoing a sponsored bridging course in order to rewrite the National Senior Certificate matriculation examinations in Maths and Science. Many of the students had passed both subjects in 2002, but on the Standard Grade, which would not qualify them for university entrance. Most of the students in both Treatment groups had written English Second Language on the Higher Grade.

The selection/admission procedures for Treatment Group 1 at the sister College and Treatment Group 2 at our College differed. All the students were interviewed and their results for the National Senior Certificate were reviewed. However, Treatment Group 1 was required to complete the L.P.CAT (Learning Potential Computer Assessment Test) psychometric test, developed by the HSRC, which measured the students' potential for self-directed research and possible future careers. The results were presented in percentile scores. This group also completed the 16 PF (personality factors) stanine score test. This test investigates personality types, for example, extroverts and introverts. In addition, a Maths test, also developed by the HSRC to test 1st year university students, was administered. The students were not tested in Science, nor in English (except in the interview). On the basis of these tests one class comprising 25 students was selected, all sponsored by the mining company. This was the class that formed Treatment Group 1 which functioned as a 'control' group.

At our College in 2003, some of the students wrote a general aptitude test (also developed by the HSRC) on the Senior level. A battery of 12 tests assessed verbal and numerical aptitude; visual-spatial reasoning; clerical and mechanical aptitude and memory. Raw scores were converted to stanine scores that indicated a profile for each student in Language, Maths, Science, Commerce, Technology and Humanities. Other students were assessed by their sponsors, but I was unable to ascertain which tests were used. As some of the sponsors are not South African companies, the tests were probably developed in other parts of the world, for example, the USA. All the Science/Maths students at our College wrote the internal Maths and Science performance test (cf. §1.5.1). Sponsorship was such that four classes of students could be selected, some classes containing weaker students who were given a chance to improve their results.

The students in both Treatment Groups came from previously disadvantaged academic and economic backgrounds and had an average age of 19 years. All the students completed an English communication course; a life skills course; technical drawing and a computer skills course for 2003. All the students were taught in English and exposed to an English teaching environment for the academic year 2003. The students in Treatment Group 2 were also exposed to the largely English-speaking environment of campus life on the Wits Education Campus (formerly JCE), but Treatment Group 1 lived in a hostel on company premises where the majority of students are Black and so they were not exposed to an English environment outside the lecture rooms.

Treatment Group 1 at the sister College originally consisted of 25 students, two of whom were female. These students were of varying ability in Maths, Science and English language proficiency. Two male students dropped out during the year, leaving 23 students in this group. All 23 of the final group wrote both the pre-tests and the posttests.

Treatment Group 2 at our College consisted of 66 Science students, 16 of whom were females. (There was a further group of 17 students, but they studied Accounting. While they were also tested and pursued the reading units in Accounting, their results were not included in this research). Two students were absent for or attending interviews during some of the posttests and one student arrived late at the beginning of the year, thus missing some pre-tests. In the final instance, 63 students' marks for pre- and posttests were used as data for this research – the ratio was 15 females to 48 males.

The structure of our English Communication course at the College was also changed during 2003. Instead of teaching one class for four hours per week, I now taught two hours of reading and writing skills to four classes (one being the Accounting class) per week. Another two-hour module, addressing speaking, emotive language and certain writing skills, was taught by my colleague. As a result, I was able to implement the reading course in all the classes and link this with vocabulary skills and writing skills. Where time permitted, the classes read newspapers and magazines in class. In total, Treatment Group 2 had four hours of English training per week, of which two hours were devoted to reading.

In Treatment Group 1, eight hours per week were devoted to English Communication, that is, these students had four more hours per week of training in English than Treatment Group 2. Thus, due to factors beyond my control, I was in the unfortunate position of having a "control" group who was exposed to double the amount of English class time, compared to that of the "intervention" group. This was a further reason for only loosely comparing the two groups. Treatment Group 1 was taught by one teacher only and the 'syllabus' covered general language proficiency, as does ours. The English Communication teacher estimated that roughly 40% of the Treatment Group 1 students' time was spent on general reading and vocabulary activities. The teacher, together with the class, read short stories for one hour a week. In addition, the group read scientific journals and newspapers during class time. No specialised reading course was implemented with this group, but they were exposed to extensive reading during the course of the year.

Treatment Groups 1 and 2 wrote the amended reading proficiency pretests as detailed earlier (cf.§3.7.4), in February 2003, and completed the language and reading habits questionnaire. Both wrote the vocabulary and spelling tests and were tested for reading rates.

The English internal examination results were collected from the Treatment Group 2 in June and September. The English examination results were collected for Treatment Group 1 in June, but they did not write an examination in September. Instead, they wrote a series of tests and these results were forwarded in October. Treatment Group 1 also did not write a preliminary Science examination in September, so the Science results were collected for all the students in June and for the final Science examination, the results of which were released in December 2003.

Both Treatment Groups then rewrote the reading posttests, the vocabulary test, the spelling test and were re-tested for their reading rates in September 2003.

Oral information about improvements in vocabulary, reading and writing skills was collected from my colleagues in the Science, Life skills and English courses. The students in both the groups were asked their opinions about the tests, and Treatment Group 2 gave their views orally about the reading programme. The Maths teachers were also asked if they could

comment on any improvements in the language proficiency of the students. My own observations, after teaching Treatment Group 2 for the academic year, were also noted.

3.8.2 Intervention procedures

Treatment Group 2 worked through the S*T*A*R*T reading programme for two hours every week throughout the year. They completed five Science units in Level 2 of the reading programme during the course of the year. One further unit was set as a self-study assignment in the June/July vacation. The students were allowed to choose this unit by themselves from those in the manual. This meant that they had to read parts of all the units in order to make their choice. The students worked through several units on their own in class, following the instructions and the structure of the course, as explained before, and writing their answers down. I then went over each unit and we read the expository texts aloud and discussed their answers. I began certain units with them, that is, we discussed the Purpose, Activate background knowledge and Survey sections. The students then went on to Study read, Summarise and Synthesise by themselves and together we checked their answers. As mentioned before, I had only expected one intervention group in 2003 so just one set of the reading programme manuals had been ordered and the budget did not extend to more at such short notice. As a result, the students had to share the books and were unable to work through the units for homework and were thus considerably slower in finishing units than the pilot study group had been. Fewer units than anticipated were therefore completed by Treatment Group 2 in 2003 and there was no time to move to Level 3 of the course.

In conjunction with the reading course, and often using the material in the various units, the students were also taught vocabulary skills. They were taught to use their dictionaries and thesauruses. Vocabulary exercises such as blockwords and word puzzles were set as homework. The students were taught to guess from context by using morphological and semantic clues. A great deal of time was spent on teaching semantic relations and the markers that signal them, for example, causal and conditional text-semantic relations. Spot spelling tests occurred throughout the year. Extra time was spent on practising summary skills, both written and tabulated. Ordering/unscrambling sentence exercises, in order to grasp the underlying semantic relations, were also practised often by the students and set as questions in the internal English examinations. (It was for this reason that the English results were used

only as a comparison in the results presented in Chapter Four, i.e. the techniques taught during the reading programme were tested and thus contributed to the overall English scores, (cf. §4.4.3).

Treatment Group 1 at our sister College continued with their normal 'syllabus', using a variety of materials such as newspapers, magazines, reports, etc.

3.8.3 Assessment procedures

Both Treatment Groups wrote the pretests in early February 2003 as explained in the previous section (cf. §3.8.1). My colleague teaching the control group administered the tests to this group with my instructions. The tests were sent to me for marking and collating.

After seven months (i.e. in early September 2003) the students in both groups rewrote the reading tests, the vocabulary test and the spelling test. They were also re-assessed for reading rates. At no time had these tests been seen by the students or discussed with them by me or my colleague during the course of the year. All tests were marked by me and I collated the results. These results were then statistically analysed using the SPSS computer programme. At the end of the year, after the posttests, the students were offered the opportunity of viewing their year's reading test results but few availed themselves of this opportunity.

The students' Science results and their English results, which were collected during the year, were statistically computed. The final National Senior Certificate Science examination results were collected when released at the end of December 2003 and statistically analysed.

3.9 Conclusion

This chapter detailed the procedures adopted for the pilot study and the main study of this research project. Owing to changed circumstances, the procedures adopted for the two studies differed, but the research design remained the same. As explained, in the pilot study, two intact classes from our College with an equivalent exposure to English lectures were used as the control and intervention groups. In the main study, as a result of factors beyond my control due to management decisions, the 'control' group (i.e. Treatment Group 1) was an intact group

'inherited' from another College who was exposed to eight hours of English training whereas the intact 'intervention group' (i.e. Treatment Group 2) at our College was only exposed to four hours of training, two hours of which were devoted to the reading programme.

The results of the pilot study were also presented and discussed in this chapter. The results of the main study are presented in Chapter Four, together with a discussion of the statistical analyses and the qualitative information collected during the course of this quasi-experimental study.

CHAPTER FOUR

RESEARCH FINDINGS OF THE MAIN STUDY (2003)

4.0 Introduction

In this chapter the findings of the intervention programme are presented and discussed. The findings are presented in chronological order, beginning with the qualitative data collected at the start of 2003, progressing to the results of the descriptive and inferential statistics collected during the course of the year. A discussion follows the presentation of each set of data in which possible reasons for the outcomes are put forward. In addition, after the outcomes of the reading programme have been discussed, an insider perspective (my own as teacher and facilitator) is presented to round off the findings.

4.1 The participants

For the current quasi-experiment, the results of the pre- and posttest reading tests, vocabulary tests, reading rate assessments, spelling tests, English scores and Science scores of the 86 students who participated in the study were collected and statistically analysed, using the SPSS programme. The students were in institutionally occurring groups: a Treatment Group 1 of 23 students and an intervention group, Treatment Group 2 of 63 students (originally 66). These groups were 'intact classes' (Tuckman 1988:124) as the students had already been assigned to these classes by the Colleges before the intervention programme began. As mentioned previously in §3.8, although the students from the two groups came from the same economically and educationally disadvantaged backgrounds, it became obvious as the year progressed that Treatment Group 1 was an academically stronger group with less variance in scores (i.e. more homogenous) than Treatment Group 2. The standard deviation (SD) in each set of statistics bears this out. Further, both groups were exposed to an 'input-rich' environment of experienced and highly qualified teachers, good facilities and intensive study for an academic year. It was thus to be expected that the students would all show an improvement in their results by the end of the year, which was indeed the case and always is, as 12 years of teaching experience at this particular College has shown.

4.2 Qualitative Findings

This subsection details the qualitative information collected at the start of this quasi-experiment conducted in 2003. It includes anecdotal information from an insider's perspective as well as information from questionnaires distributed to the participants.

4.2.1 Questionnaire on language profile and reading habits

All the participants in the current study answered a questionnaire on their language backgrounds and their reading habits in February 2003.

4.2.2 Language profile

The majority of the students in Treatment Group 1 were either speakers of Setswana or Tshivenda. Four students had isiZulu as their L1; isiXhosa, Sesotho and Xitsonga speakers were also represented in the group. One student was Afrikaans speaking. Half of the group was able to read/write or speak at least one other language (not English); many were multi-lingual. The other 50% of the group spoke, read and wrote English, Afrikaans and their home language only.

In Treatment Group 2, 50% were Setswana speakers. Of the remainder, 35% spoke either Sesotho or Sesotho sa Leboa. Six students were Zulu-speaking; two spoke isNdebele and only one student had Tshivenda as an L1. As in Treatment Group 1, half of Treatment Group 2 was multilingual while the other 50% spoke, read and wrote English, Afrikaans and their home language.

In both groups, the majority of the students (83% and 73% respectively) had started studying other subjects in English in Grade 5 in accordance with the ex-DET system of education. The remainder of the students studied all subjects in English from Grade 1. Two students in Treatment Group 2 only started studying other subjects in English in Grade 8. Of all the participants, only 20% were unable to continue studying their first languages until Grade 12. In these cases, their first languages were not offered at the ex- Model C secondary schools that they attended.

4.2.3 Reading habits

Of the 86 participants in this research, only five admitted to disliking reading. They maintained that reading tired them. The rest of the participating students claimed to enjoy reading – most of them recognised the value of reading for improving communicative skills (written and spoken). They also commented on the improvement of vocabulary through reading. Further, 90% of the students commented on reading as a means of gaining knowledge, both general and academic. The students' responses showed that they were keenly aware of the tenet 'reading to learn'. These responses were aptly summed up by a student who maintained that 'readers are leaders'. However, the underlying feeling seemed to be that reading was a demanding task, albeit necessary. Only two students stated that reading was a pleasurable activity, not only a study activity – 'it raises your spirit' and 'it can relax your mind'.

When questioned on how often the students read generally, the responses were as follows:

Table 4.1 Frequency of reading

How often do you read?	*86 students' answers*	*Percentage %*
Every day	37	43%
Weekly	27	32%
Sometimes	22	25%

No-one used the 'never' option offered in this item. When questioned about their preferred reading materials (the students were allowed to tick more than one option), the majority of them chose newspapers and magazines. Textbooks[3] were also popular reading materials as were short stories. Few students favoured novels, plays, poetry or comics. One student who chose the 'other' option stated that his preferred reading material was the Bible. The other few who chose the 'other' option referred to reference books, for example, encyclopaedias. These responses are reflected on the following page in Table 4.2.

[3]'Textbooks' was used in the broadest sense, meaning reference books, because few students understand the latter term.

Table 4.2 Responses to the questionnaire regarding preferences with regard to reading material

Reading materials	*86 students' responses*	*Percentage %*
Newspapers	69	80 %
Magazines	75	87 %
Short stories	54	63 %
Novels	47	55 %
Poetry	19	22 %
Plays	22	26 %
Textbooks	57	66 %
Comic books	22	26 %
Other	8	9 %

Very few students were able to name their favourite authors, which was the requirement of Question 6. With little exposure to novels or 'reading for pleasure' in their communities and schools this was understandable. Instead, the students named authors with which they were familiar as a result of their secondary schooling. The most named author was thus Shakespeare. Many students also named *Maru* by Bessie Head as their favorite novel – this is the matric setbook that they all had to read. From these responses it was obvious that the only fiction reading that the students do is school-based, very few 'read for pleasure'. With regard to Question 7 which asked about favourite books/magazines/newspapers, *The Sunday Times*; *Sowetan* and *Drum* were the newspapers and magazines most read.

The final question required the participants to describe how they liked to read, that is, silently, in groups, out aloud, etc. Again, students were allowed to choose more than one option. However, 78 out of the possible 86 chose reading silently (91%). Eight students chose to read in groups, seven chose 'students reading out aloud' and only four chose 'teacher reading out aloud'.

4.3 Quantitative Findings

This subsection details the quantitative findings collected during the intervention period (2003) and presents the statistical analysis of this data.

4.3.1 Statistical techniques

To assess the effects of the intensive reading programme, *t*-tests were used for a comparison of the results between the two groups. Although the two groups were considered different, according to the Shapiro-Wilk test, normality could be assumed in 90% of the variables in each case and so parametric tests were deemed appropriate. Levene's test for equality of variances (or homogeneity) was also applied to the sub-components of the reading tests (the p values were found to be > 0.05) and in only one case could equal variances not be assumed (i.e. $p < 0.05$). As is standard statistical practice, the degrees of freedom were therefore adjusted before proceeding with the *t*-tests. ANOVA (Analysis of Variance) tests were used to compare the results of low to high reading ability groups and their subsequent performance in Science. The ANOVA test determines whether differences between the groups are greater than the differences within the groups. Pearson Product Moment correlations were used to find any emerging patterns that might exist between reading ability and performance in Science.

In a quasi-experiment such as this one, research hypotheses are presented for investigation. It is always hoped that these hypotheses will be accepted, for example, that it can be shown that there was a significant difference between the groups of participants or that there was a significant relationship between the variables in the quasi-experiment. In the current study a significant difference needed to be established between Treatment Groups 1 and 2 with regard to their reading ability after Treatment Group 2 had undergone an intensive reading programme. Secondly, a significant relationship needed to be established between reading ability and performance in Science in both groups. If no such significant difference or relationship is found, then one accepts a null hypothesis. The null hypothesis states that groups will be equal, or that there will be no significant relationship between specific variables. For a relationship to be deemed significant, a probability (p score) of less than 0.05 (i.e. $p < 0.05$) is considered as an acceptable level of confidence to reject the null hypothesis in the social and behavioural sciences. This level means that there is a 5% chance that a significant result was found where none existed. A $p < 0.10$ score means that there is a 10% chance that the obtained differences are due to chance. A highly significant difference is considered to be at the 1% level (i.e. $p < 0.01$).

When two means are compared to establish whether there is a statistically significant difference between those means, the *t*-test is an appropriate test. The *t*-test can be a two sample (independent) test, such as a comparison of the reading averages for Treatment Group 1 and Treatment Group 2 in this study, or it can be a paired samples (non-independent) test (Brace, Kemp & Snelgar 2002:67) which is used to compare pre- and posttest differences within each group. When more than two means or groups are compared, an appropriate test is the *F*-test which is based on an analysis of variance – ANOVA. This test compares the variability of scores within groups with the variability of scores between groups. In this study the procedure was used to compare different reading groups and their differing performance in Science.

The Pearson Product Moment correlation technique explores possible relationships or associations between variables. Here the perfect correlation expressed as a score *r*, is regarded as 1.00. In contrast, a negative correlation (-1.00), indicates that an inverse correlation between two variables may exist or that there is no correlation between variables at all. The significance of the obtained correlation is also assigned a probability (*p*) score. Mulder (1986: 73) suggests the following guidelines for the *r* scores between these two parameters:

0.80 – 0.99 = very high correlation
0.60 – 0.79 = high correlation
0.40 – 0.59 = moderate correlation
0.20 – 0.39 = low correlation
0.01 – 0.19 = very low correlation.

4.4 Results of the reading tests

In the subsections that follow, the results of the reading pre- and posttests and the vocabulary pre- and posttests are presented and discussed, together with the insider perspective.

4.4.1 The reliability of the reading tests and the vocabulary test

The reliability of the reading tests and vocabulary test was tested by means of the (alpha) Cronbach test. This test measures how reliably a set of variables measures a construct – reading in this case. Reliability scores or coefficients of between 0.60 and 0.70 are considered

satisfactory, while higher scores (0.80) are regarded as desirable. It is suggested that any possible irregularity in the test process, for example administration of tests, timing, marking, etc., could account for low coefficients.

Reliability scores for the different reading components (viz. comprehension, anaphoric resolution, semantic relations and vocabulary) were calculated for each of the four tests administered. The four tests comprised the Treatment Group 1 pretest, Treatment Group 2 pretest, Treatment Group 1 posttest, and Treatment Group 2 posttest. The reliability coefficients obtained were 0.51, 0.61, 0.79 and 0.76 respectively. It is noted here that the pretest coefficients for Treatment Group 1 and Treatment Group 2 are relatively low, particularly those of Treatment Group 1. From experience, I believe this low coefficient can be explained in terms of the timing of the tests and the format of the reading tests themselves. All the students are overwhelmed when they first begin their bridging year. Many have never been taught solely in English, nor have they worked for as many hours in a day as they do at the Colleges (their day begins at 8.15 a.m. and ends at 5.15 p.m. with tea and lunch breaks). It is in this situation that they write the pretests. Secondly, the students have probably never seen such tests before, for example, the anaphoric test. This could account for a lower Cronbach coefficient. As can be seen, by the end of the year the coefficients are much higher, probably because the students are far more settled and have seen the format of the posttests before in this test/retest quasi-experiment.

4.4.2 Hypothesis 1

The hypothesis presented in §1.8 was as follows:

H1 *After an eight-month reading intervention programme (incorporating vocabulary strategy training) with an intervention group (Treatment Group 2), there will be a significant difference in the reading abilities of the intervention (Treatment Group 2) and control (Treatment Group 1) groups respectively, as reflected in the pre- and posttest reading scores.*

The null hypothesis is formulated as follows:

H01: *After an eight-month reading intervention programme (incorporating vocabulary strategy training) with an intervention group (Treatment Group 2), there will be no significant difference in the reading abilities of the intervention (Treatment Group 2) and control (Treatment Group 1) groups respectively, as reflected in the pre- and posttest reading scores.*

To test the research hypothesis, the averages of both the pre-and posttest reading scores and the separate vocabulary scores of both groups were calculated. The *t*-test procedure was applied to these calculations and *p*-values computed to ascertain whether significant differences between the two groups' scores could be found. The results of these statistical analyses are presented in §4.4.2.1. The reading rates are presented in §4.4.2.2**,** although these rates were not tested for significant differences – as explained in this section.

4.4.2.1 The results of the reading pre- and posttests

In this section the descriptive statistics are first given, followed by the results of the inferential statistics. In Table 4.3 on the following page, the averages for each component of the reading and vocabulary pre- and posttests, calculated in percentages, are presented. The SD results are presented in brackets next to the averages. In addition the ranges of scores (also in percentages) for the reading pre- and posttests of the two groups are presented in Table 4.4. The results of the inferential statistics are presented thereafter, in Tables 4.5 and 4.6. For ease of discussion, the Treatment Groups are referred to as TG 1 and TG 2 in all the tables presented in this chapter from this point forward.

Table 4.3 The averages of the reading and vocabulary pre- and posttests

		TG 1 n=23	TG 2 n=63
Mean reading score	*Pretest*	60 (7.6)	58 (11.3)
	Posttest	65 (8.4)	64 (10.4)
	Gains	5	6
Anaphoric resolution	*Pretest*	71 (11.3)	68 (15.1)
	Posttest	78 (9.4)	76 (12.7)
	Gains	7	8
Semantic relations	*Pretest*	46 (13.2)	44 (15.0)
	Posttest	48 (14.6)	49 (15.6)
	Gains	2	5
Comprehension	*Pretest*	62 (9.6)	60 (12.6)
	Posttest	66 (10.7)	65 (12.0)
	Gains	4	5
Vocabulary	*Pretest*	71 (9.0)	69 (12.4)
	Posttest	75 (7.6)	76 (10.2)
	Gains	4	7

Table 4.4 The range of results in percentages for the two groups in pre- and posttest reading results

	Pretest	**Posttest**
TG 1 n= 23	**46% - 79% (33)**	**47% - 79% (32)**
TG 2 n= 63	**29% - 81% (52)**	**41% - 83% (42)**

As can be seen from the above tables, in both groups gains were made from the pre- to posttests. After a year of exposure to English training which included reading, this was anticipated. Treatment Group 1 showed greater homogeneity as is reflected in the smaller standard deviations and range of scores. Treatment Group 2 appeared to be a more heterogeneous group with greater standard deviations and a greater range of scores. In the latter group it is also interesting to note that there were no failures in the reading posttests while there were in the pretests. As a result, the range of scores in TG 2's posttest is 10% smaller and the lowest results from pre- to posttests increased from 29% to 41% (12%).

Two-sample (independent) *t*-tests were then used to test for a significant difference between the average result Treatment Group 1 and the average result of Treatment Group 2 for each component of the reading tests and for the vocabulary tests in the posttests. The results are presented below in Table 4.5:

Table 4.5 Difference between the mean reading and vocabulary posttest scores of Treatment Group 1 and Treatment Group 2

	t	**df**	***p* value**
Overall reading mean	**.41**	**48.09***	**.69**
Comprehension	**.33**	**84**	**.74**
Anaphoric resolution	**.74**	**84**	**.47**
Semantic relations	**-.12**	**84**	**.90**
Vocabulary	**-.57**	**84**	**.58**

* As will be recalled from §3.2 and §4.3.1, Levene's test for homogeneity, required that the degrees of freedom be adjusted in this particular case to accommodate the differences between the two groups.

Table 4.5 indicates that there were no significant differences in the posttests between the two groups with regard to the average results of the components of the reading tests and for the vocabulary test.

To further investigate the findings, the *changes* in reading scores of the two groups between the pre- and posttests were examined. Paired sample *t*-tests (i.e. non-independent tests) were used to ascertain whether there were any statistically significant differences with respect to each component of the reading tests and the vocabulary tests in Treatment Group 1 (pre-and posttests) and in Treatment Group 2 (pre- and posttests) respectively. The results are presented on the following page in Table 4.6.

Table 4.6 Differences between pre- and posttest scores of Treatment Group 1 and Treatment Group 2 respectively.

	t	df	*p* value [1]
Mean reading tests			
TG 1	**-3.3**	**22**	**0.003****
TG 2	**-6.4**	**62**	**0.000*****
Comprehension			
TG 1	**-1.7**	**22**	**0.099****
TG 2	**-3.9**	**62**	**0.000*****
Anaphoric tests			
TG 1	**-3.1**	**22**	**0.006****
TG 2	**-5.3**	**62**	**0.000*****
Semantic relations			
TG 1	**-.10**	**22**	**0.329**
TG 2	**-2.6**	**62**	**0.011***
Vocabulary			
TG 1	**-2.3**	**22**	**0.033***
TG 2	**-7.4**	**62**	**0.000*****

[1] *** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

The findings presented in Table 4.6 indicate that changes in the reading scores of the two groups had occurred during the year (i.e. from pre- to posttests). Treatment Group 1 showed improvements in all areas except semantic relations at the $p < 0.0$ level, while Treatment Group 2 showed improvements in all components of the reading tests, with improvements highly significant ($p < 0.001$) in every component except the semantic relations tests which were still significant at the $p < 0.05$ level.

4.4.2.2 Results of the reading rate tests

The results of the reading rate pre- and posttests could not be accurately computed and so the given measures are only a very general indication of the mean reading rates of the students. In some cases the students obviously did not time themselves properly and were subsequently excluded from the averages of the two groups. For example, in Treatment Group 1, two students stated that the time taken to read the second passage of 506 words was one minute, which I found to be highly improbable. In Treatment Group 2, four students were absent for either the pretest or the posttest, while one also miscalculated his time. The numbers (n) for

the reading rate tests thus differ from those for the rest of the tests. The results are tabulated in Table 4.7.[4]

Table 4.7 Results of the reading rate assessment

	Pre-test	**Pre-test**	**Posttest**	**Posttest**
	R. Rate	**Comprehension**	**R. Rate**	**Comprehension**
TG 1 n=21	136 wpm.	58 %	140 wpm.	62%
TG 2 N=61	121 wpm.	70 %	123 wpm.	72 %

4.4.2.3 Discussion of the reading test, vocabulary and reading rate results

As can be seen from Table 4.3, Treatment Group 1 had marginally higher results than Treatment Group 2 throughout and had a smaller standard deviation or range of results. (This pattern repeated itself in the Science scores for the two groups which are presented later in Table 4.8). It seems reasonable to presume then, that Treatment Group 1 was an academically stronger group with fewer weaker students than Treatment Group 2. Both groups improved their reading test and vocabulary test results in the posttests, which was to be expected after an enrichment year and after writing the same pretests.

As indicated by Table 4.5, it was not possible to reject the null hypothesis at the $p < 0.05$ level for significant differences in average reading results for the two groups. There was therefore insufficient evidence to claim that there were significant differences in posttest reading scores between Treatment Group 1 and Treatment Group 2 after the implementation of an eight-month reading programme with the latter group.

However, considering the results presented in Table 4.6, which dealt with the differences in pre-and posttest scores of the two groups, a more encouraging picture emerges. There was a highly statistically significant improvement, $p < 0.001$, between the pre-and posttests with regard to overall reading scores and anaphoric scores in Treatment Group 1. Their vocabulary scores and the scores for the comprehension tests also showed significant differences at $p < 0.05$. Only in the semantic relations scores was there no significant difference. In contrast,

[4] R. Rate indicates reading rate in words per minute and Comprehension indicates a percentage reading comprehension score.

Treatment Group 2 shows highly significant differences of $p < 0.001$ on all scores except that of the semantic relations test, which showed a significant difference at $p < 0.05$.

Treatment Group 1 had been exposed to extensive reading for the academic year and it seems reasonable to expect that their reading scores and vocabulary scores would improve. Their increased anaphoric resolution was also probably as a result of increased exposure to reading and improved reading ability. Possibly semantic relations had not been specifically taught to them and so their abilities in this area did not improve.

Treatment Group 2 had been exposed to an intensive reading programme and according to their results, the beginnings of an improvement in reading ability are apparent. Semantic relations had been taught to the students as part of the reading course and their improved scores reflected this. It could be suggested that the natural maturation of the students accounted for the improvements, but that being the case, Treatment Group 1's results would also all have improved at the same level as those of Treatment Group 2 – which they did not, despite their being an academically stronger group.

The statistically significant improvement in the vocabulary results of Treatment Group 2 was encouraging. Vocabulary strategy training had been implemented as part of the intensive reading programme, and it seems to have been instrumental in improving this group's vocabulary knowledge.

As discussed previously in §3.3.1, all the reading rate comprehension scores of the students in both reading rate pre- and posttests were included in Table 4.7, even though many had comprehension scores of below 75%. (The comprehension questions had been set on the reading passage to prevent the students from mindlessly skimming through the passage without comprehending what they were reading). Unlike Lai (1993) who used 75% as a cut off point for reading comprehension scores when determining reading rate and excluded lower scores, in the current study the cut off point was accepted at 70% which was felt to be a good indication of reading comprehension and all scores were included. This meant that the reading rate score of any student scoring a greater or lesser percentage than 70% would not be considered entirely accurate but was nevertheless included in the overall results. The results of Treatment Group 1 show a percentage below 70% in both pre- and posttests, and this seems to indicate that their

reading rate scores should be lower for both tests. Treatment Group 2's scores were at the 70% level and so their reading rate scores were considered to be more reliable. Both groups showed a small gain in reading rate scores, and the gain, though modest, was encouraging. In Treatment Group 2, 22% of the students had reading comprehension scores of 90-100% for this test and it was felt that their reading rates were higher than reported. For example, one skilled reader reported a 102 wpm reading rate with a comprehension score of 100% and this seemed to indicate a much higher reading rate, or possibly a more cautious reader in a test situation. In contrast, scores of 120 wpm with comprehension scores of 30% seemed to indicate that the students had just skimmed through the passage without understanding or retaining any of the information presented in the passage and that for comprehension, their reading rate would have to be slower. These students would also need to improve their comprehension strategies.

In summary, this quasi-experiment was unable to reject the null hypothesis **H01**. Although both groups improved, the results indicate that there was no *significant* difference in the reading results between Treatment Group 1 and Treatment Group 2 with regard to the different reading scores and vocabulary scores. However, failure to reject the null hypothesis should not be seen as evidence for rejecting the potential benefits of an intensive reading programme. Owing to factors beyond the researcher's control, both groups were exposed to reading throughout the year, so it was expected that their reading scores would improve. In addition, Treatment Group 1 had more exposure to English teaching. Given these conditions, one cannot claim that the intensive reading course produced better results than the reading to which Treatment Group 1 was exposed, yet the vocabulary results seem to suggest that intensive reading, in conjunction with explicit vocabulary strategy training, has considerable benefit for students. The differences between the groups were detected in other areas, for example, changes in original scores and improvements in scores in the two groups. The ranges presented in Table 4.4 also show differences between the groups. Treatment Group 1 had no results below 40% in the reading pretests, while Treatment Group 2 had four results below 40%, (29%, 33%, 36% and 37%), but none in the posttests. While Treatment Group 1 showed much the same ranges in the pre- and posttests, Treatment Group 2 showed a greater improvement in the lowest range for the posttest result. The weaker readers in Treatment Group 2 had therefore improved their scores to above 40%, possibly as a result of the reading intervention programme and having been exposed to more practise in reading. When one

considers that Treatment Group 1 was exposed to double the amount of English tuition compared to Treatment Group 2, it would seem to indicate that the discrepancy in scores should be higher, in favour of Treatment Group 1. It appears therefore that the Treatment Group 2, while a weaker group with less exposure to English and reading, did manage to hold their own against Treatment Group 1 in improving reading skills. This suggests that a reading programme did assist them in improving their reading skills.

All in all, the reading rates of both groups indicate that their reading rates are too slow for these students to be able to cope in an academic environment in which a number of reference books have to be read, and read quickly. Bohlmann & Pretorius (2002)(cf §2.5) suggest that as the students were not studying the text (i.e. 'reading to learn'), but reading for the purpose of answering questions based on the text, a reading rate of 160 wpm was reasonable. Most of the students in both groups had reading rate scores far below this rate, and therefore would probably still find the reading and understanding of expository texts a problem. Further, the findings of this study suggest that the relationship between reading rate and comprehension amongst L2 readers is a complex one which merits further investigation by researchers.

4.4.3 Hypothesis 2

The second hypothesis that was proposed for this research was to examine a possible relationship between reading ability and academic performance in Science. An ability in Science does not necessarily hinge on reading ability, as these two abilities derive from different skills and knowledge. If a student has no scientific ability, good reading skills will not improve his/her performance in Science and conversely, poor readers can excel in Science. However, it seems reasonable to suggest that poor reading skills can act as a barrier for students who have ability in a subject such as Science which relies heavily on interpreting word problems. Improving reading skills through extensive or intensive reading could therefore possibly have a spin-off effect on performance in Science.

In this subsection the English scores of the two groups are also presented. These scores are for comparison only, as reading ability contributed to this score. In other words, the students were tested on all aspects of English language proficiency, for example, speaking and writing, and reading ability was also one such aspect. Many questions in the internal English examinations

involved reading skills as well (e.g. comprehension) in both groups. Because of the covariance between an ability in English and reading ability, it was felt that the English scores could not be compared with the reading scores – the English scores are thus presented only to provide a broader picture of the relationship between reading, English proficiency and a possible effect on Science.

The second hypothesis was formulated as follows:

H 2: *There will be a significant relationship between academic performance in Science and reading ability.*

The null hypothesis is formulated as follows:

H02: *There will be no significant relationship between academic performance in Science and reading ability.*

4.4.3.1 Results of the Science exams

For later discussion and for comparison, it was considered worthwhile to first present the mean reading scores and vocabulary scores in percentages for pre- and posttests (these scores were originally presented in Table 4.3 in the previous section) together with the Science scores for June and the final Senior Certificate examination (October 2003), for both groups. In addition, the English scores in percentages are presented for the June and September 2003 examinations. These averages are all presented in Table 4.8 on the following page.

Table 4.8 The mean reading, vocabulary, Science and English scores in 2003 of Treatment Group 1 and Treatment Group 2

		TG 1 n=23	TG 2 n=63
Reading mean	*Pretest*	**60 (7.6)**	**58 (11.3)**
	Posttest	**65 (8.4)**	**64 (10.4)**
	Gains	**5**	**6**
Vocabulary	*Pretest*	**71 (9.0)**	**69 (12.4)**
	Posttest	**75 (7.6)**	**76 (10.2)**
	Gains	**4**	**7**
Science	*June*	**74.8 (11.4)**	**56.6 (12.5)**
	Final	**71 (8.8)**	**64 (13.0)**
	Gains	**-3.8**	**7.4**
English	*June*	**66 (7.1)**	**55.7 (12.2)**
	September	**61 (7.5)**	**55 (13.4)**
	Gains	**-5**	**-.07**

Again, to further explore the findings the ranges, from lowest to highest in raw score percentages, are presented for both groups. These are tabulated on the following page in Table 4.9:

Table 4.9 Ranges (in percentages) of the reading, vocabulary, English and Science scores of the two groups for initial and final results

Subject	TG 1 n=23	TG 2 n=63
Reading		
Pretest	**46% -79% (33)**	**29% - 81% (52)**
Posttest	**47% -79% (32)**	**41% - 83% (42)**
Vocabulary		
Pretestt	**57% - 87% (30)**	**42% - 92% (50)**
Posttest	**58% - 88% (30)**	**50% - 98% (48)**
English		
June result	**53% - 75% (22)**	**30% - 80% (50)**
Final result	**48% - 72% (24)**	**41% - 81% (40)**
Science		
June result	**49% - 93% (44)**	**30% - 85% (55)**
Final result	**53% - 89% (36)**	**31% - 90% (59)**

4.4.3.2 Discussion

As can be seen from Table 4.8, Treatment Group 1's average scores for all scores except the posttest vocabulary score are once again higher than those of Treatment Group 2, exhibiting smaller ranges or standard deviations. While the difference between the two groups with regard to reading and vocabulary averages is small, the difference becomes more marked when one compares Science scores, with Treatment Group 1 outperforming the Treatment Group 2 in both June and the final Science examination. In the English scores too, Treatment Group 1 appears to be an academically stronger group. The Treatment Group 2's Science scores show an improvement or gain of 7.4% between the two examinations, whereas the Science average of Treatment Group 1 dropped by 3.8%.

The ranges of the results in raw scores indicated in Table 4.9 possibly give a better indication of what transpired during the year in the two groups. Treatment Group 1's results remained relatively stable and at a higher percentage than those Treatment Group 2 for the year, with few extreme range changes from first to final results. The results do, however, show a drop in marks for English and Science, possibly as a result of the final assessments being more demanding than the June assessments. In the final Science examination, four students in

Treatment Group 1 achieved A symbols for Science. Treatment Group 2 showed greater improvements in reading, vocabulary and English. It also appeared that the weaker students in this group benefitted more from the reading intervention programme, judging from the differences between their pre- and posttest reading results (29% and 41% respectively). The range of the Science scores in this group showed higher results in the final examination, while the lowest results remained much the same for the failures. In Treatment Group 2, eight students achieved A symbols for Science and two failed at Higher Grade level. Treatment Group 1 had no failures in Science, as shown in Table 4.9. Again it can be seen that Treatment Group 2 had changed in several respects and it is my contention that one of the contributing factors was the implementation of an intensive reading course.

4.4.3.3 The Pearson Product Moment Correlations

To further investigate a possible relationship between reading ability and its possible effect on Science, the correlations between all the components of the reading tests, vocabulary, and Science were calculated for the both groups. For the purposes of this study, the correlations between the posttest overall averages for reading, vocabulary, and Science are presented. The initial reading tests and vocabulary tests were administered in February 2003 while the first Science tests were only written in June. Because of this time lapse it was thus felt to be inappropriate to correlate the pretest reading and Science results. The final tests, however, were written within a month of one another. Further, the June Science examinations were internal and so the two groups wrote different Science pretests. In contrast, both groups wrote the same reading and vocabulary tests as well as the same Science examination (i.e. the National Senior Certificate Science examination) at the end of the year. The correlation between the final overall results are reflected below in Table 4.10:

Table 4.10 Correlations (*r*) for the final overall averages, vocabulary, and Science for the two groups

	Reading	**Vocabulary**
Science		
TG 1 n = 23	***r* = 0.70****	***r* = 0.22**
TG 2 n = 63	***r* = 0.48****	***r* = 0.35****

**** $p < 0.001$ * $p < 0.05$**

As the table shows, for Treatment Group 1 there was a significant high correlation between Science and reading only at $p < 0.01$, but no significant correlation between Science and vocabulary. (A correlation of $r = 0.70$ between reading averages and Science is considered high (Mulder 1986:73).) In contrast, the correlation coefficients for Treatment Group 2 for reading and Science and Science and vocabulary are all highly significant at $p < 0.001$. Although the correlations for Treatment Group 2 were moderate, this is not surprising, given that this group was a larger group than Treatment Group 1. Whilst not reported in Table 4.10, it is of interest to report the correlations between Science and English for the two groups: in Treatment Group 1 the correlation was not statistically significant with $r = 0.27$. In Treatment Group 2, the correlation between Science and English was statistically significant at $p < 0.05$ ($r = 0.42$). Thus for both groups, the correlation between reading and Science was more significant than that between English and Science. It is also of interest to report the significant correlation between reading and vocabulary in Treatment Group 2 ($r = 0.56$, $p < 0.01$). The latter group received vocabulary instruction during the reading intervention programme, while Treatment Group 1 did not receive any formal vocabulary instruction during the year. There was no significant correlation between reading and vocabulary in Treatment Group 1 which might suggest that formal vocabulary instruction is of value for ESL students.

4.4.3.4 Discussion

These correlation results suggest that the null hypothesis H02 can be rejected on the grounds that a significant relationship was established between reading ability and academic performance, as reflected by the Science scores in Treatment Groups 1 and 2. Both groups showed significant correlations between reading ability and performance in Science, but the correlation coefficient for Treatment Group 1 was higher than that of Treatment Group 2. (The higher correlation coefficient of Treatment Group 1 may possibly have been as a result of their stronger academic performance throughout the year in Science, as indicated in Table 4.10). In addition, Treatment Group 2 showed a significant relationship between Science and vocabulary, possibly as a result of vocabulary instruction during the reading intervention programme. No causal inferences can be drawn from these correlations because, at best, correlations only show an association and there could have been a third variable (or more) that accounted for the relationship between reading ability and performance in Science. More research needs to be done to further explore the relationships between reading, vocabulary,

English proficiency and academic performance in Science for ESL students. Nevertheless, the results of both of the groups suggest that a positive association between reading ability and academic performance in Science may well exist.

Treatment Group 1 was exposed to extensive reading during a year of enrichment and although the extensive reading seemed to positively contribute to their performance in Science, no other statistically significant relations, for example, between English language proficiency and Science or vocabulary and Science could be established with the low correlations reported in §4.4.3.3.

Treatment Group 2 was exposed to an intensive reading programme and the students' results showed highly significant correlations between all the variables mentioned. This suggests that as reading ability (together with vocabulary skills) improved over the year, it contributed to improved ability in English and had a positive effect on performance in Science. Perhaps these results also indicate that specifically teaching reading skills through the implementation of an intensive reading programme (which included vocabulary training) was of more benefit than only exposing students to extensive reading at this post-matric level. However, as both groups showed significant correlations between reading ability and Science, it would seem that ideally, extensive reading together with intensive reading practices should be implemented with students. A further consideration is that Treatment Group 2 concentrated on the reading of scientific texts and this too might have contributed to the overall outcome of the above-mentioned correlations. It may be that the tenet 'read to learn' becomes more effective as 'read Science to learn Science'. This tenet can be applied to any other subject (i.e. reading across the curriculum).

4.4.3.5 ANOVA results

To further explore the overall picture of a possible relationship between reading and performance in Science, the ANOVA procedure was used. The Analysis of Variance procedure compares differences within groups with those between groups to establish whether the differences between the groups are greater than the differences within each group. From the final reading test averages, both treatment groups were divided into reading groups. The

categories used for these reading groups were those suggested by Bohlmann & Pretorius (2002: 201) which were also suitable for the current study:

1. Group 1 were those students who achieved less than 45% for their reading posttests.
2. Group 2 achieved between 46%-59% for the reading posttests.
3. Group 3 scored between 60%-74% in the reading posttests.
4. Group 4 were those students who scored 75% or higher in the posttests.

Table 4.11 below depicts the numbers of students in Treatment Groups 1 and 2 in the four reading groups, and their mean posttest reading scores together with their mean final Science results:

Table 4.11 Difference in performance in Science and reading according to reading groups

Reading Groups	**Reading Group 1** **0-45%**	**Reading Group 2** **46-59%**	**Reading Group 3** **60-74%**	**Reading Group 4** **75-100%**
TG 1 n = 23	(n = 0)	(n = 6)	(n = 15)	(n = 2)
Reading mean	**0%**	**54%**	**67%**	**79%**
Science mean	**0%**	**62%**	**74%**	**80%**
TG 2 n = 63	(n = 3)	(n = 19)	(n = 31)	(n = 10)
Reading mean	**41%**	**48%**	**69%**	**78%**
Science mean	**57%**	**49%**	**69%**	**70%**

Treatment Group 1's scores show a uniform pattern: as the reading scores increase, so too do the Science results. Treatment Group 2's scores also show an increase in Science scores across the reading groups, except for the reading Group 1 whose Science scores are higher than the Group 2 reading group. Possible reasons for this are presented in §4.4.3.6.

A one-way ANOVA procedure was used to determine whether there were any significant differences between the different reading groups (independent variable) and their performance in Science (dependent variable).

Specifically, for Treatment Group 1, with Science as the dependent variable, the results yielded a significant result: $F(2, 20) = 13.54$, $p < 0.05$. The post hoc Scheffé test showed significant differences between reading Groups 2, on the one hand, and Groups 3 and 4 on the other hand, with regard to their performance in Science. (Treatment Group 1 did not have anyone in reading Group 1 in the posttest.) In Treatment Group 2 the results were also significant: $F(3,59) = 5.47$, $p < 0.05$. The Scheffé test again indicated significant differences at $p < 0.05$ level between reading Groups 2 and 3, on the one hand, and reading Groups 3 and 4 on the other, in terms of performance in Science.

To further explore this relationship, the students were grouped according to their Science results in the final examination (academic groups). The pass mark on HG for this examination is 40%.

1. Group 1 were termed At Risk for future study with a Science result of 30-49%.
2. Group 2 were Pass with a result of 50-69%.
3. Group 3 were Achievers with results of over 70%.

The distribution of the students in both treatment groups and their mean reading scores for each academic group are shown below in Table 4.12:

Table 4.12 Differences in performance in Science and reading according to academic groups.

Academic Groups	**Group 1 (At Risk) 30-49%**	**Group 2 (Pass) 50-69%**	**Group 3 (Achievers)70-100%**
TG 1 n = 23	(n = 0)	(n = 9)	(n = 14)
Reading mean	**0%**	**60%**	**68%**
Science mean	**0%**	**62%**	**77%**
TG 2 n = 63	(n = 9)	(n = 32)	(n = 22)
Reading mean	**59%**	**62%**	**69%**
Science mean	**41%**	**61%**	**77%**

A further one-way ANOVA procedure was used to determine if there were any significant differences between the different academic groups in terms of Science performance (independent variable) and their final mean reading results (dependent variable).

With performance in the reading posttests as the dependent variable, Treatment Group 1's results yielded a significant $F(1, 21) = 5.62$, $p < 0.05$. A post hoc Scheffé test showed significant differences between the Pass Group and the Achievers Group with regard to their performance in the reading posttests. In Treatment Group 2 the results were also significant: $F(2, 60) = 4.92$, $p < 0.05$. The Scheffe test revealed significant differences between the At Risk and Pass Groups, on the one hand, and the Achievers Group on the other hand, in terms of their performance in the reading posttests.

4.4.3.6 Discussion

As these results indicate, a complex relationship emerged between reading ability and performance in Science. In general, clear differences emerged between the weaker and stronger groups both in terms of reading ability and performance in Science. Typically, students who perform well in Science can also read well, and good reading skills seem to enhance performance in Science. Out of the 86 subjects tested in this study, there were only six exceptions to these findings. These six students can be divided into three groups, namely,

(i) two students who read well but did not perform well in Science;
(ii) two students who were poor readers but achieved good results in Science;
(iii) two students who were poor at both reading and performance in Science.

The top achiever Treatment Group 2 in the reading posttests, with a score of 83%, was a student in the At Risk Science group with a score of 44%. Another student who was in Group 3 (reading) also only just passed Science in the At Risk group.

In contrast, Treatment Group 1, one student in reading Group 2 (46-59%) achieved a Science score of 75%, thus making him an Achiever in Science, despite lower reading comprehension skills. Another student in Treatment Group 2 showed similar results. This student was in reading Group 1 (less than 45%) and yet achieved a Science result of 72%. Finally, in Treatment Group 2, two students in reading Groups 2 and 3 failed Science.

One can conclude then from the ANOVA analysis that in general, reading ability and performance in Science can be linked. This relationship, however, probably depends on an aptitude for Science in the first place; and possibly on the assumption that such an aptitude does not only depend on an ability to read, that is, that other factors affect performance in Science. While good reading skills cannot guarantee good performance in Science, as suggested by the examples mentioned above, it does seem as though poor reading skills can inhibit academic performance in Science. Evidence suggests that reading proficiency does affect performance in Science and that practising reading is to the Science student's advantage. This complex relationship between reading ability and Science also needs further exploration and research.

4.5 Reading and Spelling

While formal hypotheses about the effects of intensive or extensive reading on spelling were not included in the current study, spelling tests had been administered to the students so, having the spelling data, it was considered worthwhile to explore this relationship during this quasi-experiment. The positive effects of reading on spelling ability are mentioned in Lai's (1993) research (cf. §2.3) and in Krashen (1993, in Kim & Krashen 1997:26).

The final set of data thus presented in this chapter are the spelling results of the pre- and posttests of both groups. Again, *t*-tests were used to compare the results for both groups. Again, although there was no significant difference between the averages of the two groups, both groups showed significant differences in pre- to posttest spelling scores. These results are presented in Table 4.13 and Table 4.14 on the following page:

Table 4.13 Spelling averages for Treatment Group 1 and Treatment Group 2. The SD is presented in brackets

Groups	Spelling averages
TG 1 n = 23	
Pretest	**79.5 (13.2)**
Posttest	**82.7 (11.3)**
Gains	**3.2**
TG 2 n = 63	
Pretest	**78.7 (13.7)**
Posttest	**83.2 (11.4)**
Gains	**4.5**

Table 4.14 Differences between pre- and posttest spelling scores for the two groups

	***t* - score**	***p* - value**
TG 1 n = 23	**-2.5**	**0.02***
TG 2 n = 63	**-5.0**	**0.000***

***p< 0.05 **p< 0.001**

The Pearson Product Moment correlations for posttest reading averages and spelling for the two groups are presented in Table 4.15 below:

Table 4.15 Correlations (*r*) for reading averages and spelling for Treatment Group 1 and Treatment Group 2

	Spelling
Reading	
TG 1 n = 23	**0.38**
TG 2 n = 63	**0.35***

** ***p*** **< 0.001**

4.5.1 Discussion

The spelling averages of both groups improved during the year, which was to be expected after being regularly exposed to the printed word in the classroom. Treatment Group 2 showed a

slightly greater improvement than Treatment Group 1 in their spelling results. The former group had spot spelling tests throughout the year, thus increasing their awareness of the importance of spelling in good writing. Their practise at reading may also have contributed towards this result. It was interesting to note that in Treatment Group 2 a moderate yet significant correlation was found between the reading average and the spelling results. This seems to suggest that practising reading and emphasising the importance of spelling by testing it regularly in a subject like Science has beneficial results. Better spelling skills in Treatment Group 2 were also evident in other subjects, for example English and Life Skills.

4.6 The Insider Perspective

Both groups were exposed to reading in English Communication and other subjects throughout the year. As pointed out in Chapter Three (cf. §3.7.1), Treatment Group 1 was given extensive reading practice with teacher supervision, while Treatment Group 2 practised reading through an intensive reading programme based mainly on the reading of Science texts. Both groups improved their reading abilities as was to be expected. Both groups in the current study were intact groups and little control could be exercised over Treatment Group 1 with regard to their selection into their College, choice of English syllabus or reading activities. With regard to Treatment Group 2, there was no control over selection into the group, but there was a greater opportunity to manipulate the syllabus and the students' reading activities. While an academically weaker group with a greater range of abilities, many students in Treatment Group 2 improved their reading abilities greatly. The student who received the prize at the end of the year for the most improved reader in this group had improved from 36% in the reading pretest to 59% in the posttest. Although still considered 'at risk' for further academic study, he also passed Science for the first time during the bridging course, at the end of 2003 in the National Senior Certificate examination. In contrast, the top reader overall (in both groups) was a Treatment Group 2 student who achieved 83% in the posttest – he only managed to pass Science throughout the year with an E symbol. This indicated to me that assessing students' reading abilities can also provide guidelines for career counselling. It appeared that, for this student, pursuing scientific study would not benefit him; career counselling would be a better option as his talents obviously lay in a different field of study.

Of further interest for the purposes of the current study was the fact that one of the students in Treatment Group 2 had a severe hearing disability. He had only 10% hearing ability in one ear and 20% in the other and lip read inexpertly to compensate for this. He was unable to 'hear' when instructions were issued to, or work discussed with, the students in his class because of the general noise level and so he relied on his reading ability instead. His reading result for the pretest was 46% and his posttest result was 55%. His vocabulary result improved from 40% in the pretest to 60% in the posttest. His reading rate improved from 49 wpm in February to 79 wpm in September, while his reading comprehension went from 70% to 80%. The latter percentage indicated that his reading rate was possibly higher than recorded. Bearing in mind that this student largely 'read' his way through the year as opposed to listening and speaking, it would appear that the reading programme with the practise it afforded did indeed benefit him.

The most improved Treatment Group 1 student scored 62% in the pretest and 79% in the posttest; he achieved an A symbol for Science, having also achieved the same symbol in the June examinations. It is hoped that his improved reading ability through extensive reading afforded him a better understanding of the Science texts that he read.

In Treatment Group 2, seven students had elected to upgrade their Senior Certificate English Second Language results. They studied mainly on their own with occasional extra lessons from my colleague and me. Of these students, two had failed their reading pretests. A further three experienced reading problems, achieving an average of only 43%. One student achieved 55% and one 68% in the reading pretests. All the students scored above 40% for the reading posttests, one showing an improvement of 22%. This same student also achieved 69% in the Senior Certificate English examination. She had achieved an E symbol in her first attempt at the Senior Certificate English examination, so her subsequent result was even more commendable. All these students passed the Senior Certificate English Second Language examination and all upgraded their results by at least one symbol. There is little doubt in my mind that the year's reading programme assisted them in their endeavour.

It was interesting to note that in the posttests, 16 students in both Treatment Group 1 (five students) and Treatment Group 2 (11 students) achieved lower results than they had in the pretests. This is where one has to remember the emotional factors that influence subjects. One class in the intervention group had to write one set of posttests on the first day of the fourth

term – unfortunate – but there was no other time to schedule the test. Their marks in some cases were consequently poorer than they had been in the pretests. One student in particular produced a disappointing posttest result. On enquiry it was discovered that although he had achieved excellent results in the Maths and Science preliminaries, he was very worried because he had no sponsorship to pursue further study in 2004. Happily, he later achieved an A symbol for both subjects in the final Senior Certificate examinations and a sponsor was finally found for him.

Poorer performance in posttests also indicated that a test/retest methodology can work despite objections about recall of the test and recognising the test format. Many students commented that they found the posttests easier, but equally many admitted to having very little recollection of the pretests. Students in both groups, having successfully completed the pretest, misread instructions in the posttest and despite having written the test once before, failed sections.

With regard to reading rate, the students in Treatment Group 2 definitely improved. Tasks that had taken two hours to perform, for example, a unit of the reading programme, were now accomplished in far less time. Slow readers were unable to complete their English examination in June, but managed to complete a far longer question paper in September. The reading posttests were completed within the allotted time, which was not the case in the pretests. These were all indications that the subjects were reading faster as a result of reading practise throughout the year.

Although, statistically-speaking, no significant differences were found between the reading gains of the two groups, there seems little doubt that reading improves reading – both in Treatment Group 1 and Treatment Group 2. The gains of Treatment Group 2 seem to be greater than those of Treatment Group 1 in terms of improvement during the year.

Both groups also achieved commendable results in the Science examinations, (the details of which were presented in §4.4.3.2). The students in Treatment Group 1 outperformed the students in Treatment Group 2, but many students in the latter group showed marked improvements in Science (e.g. two students improved their Science marks from a C symbol to achieve an A symbol in the final examination) and three students who had previously failed, passed the final Science examination. (Although not within the scope of the current study, it

was noted that 12 of the 23, i.e. 52% of the students in Treatment Group 1, achieved A symbols for Mathematics in the final examination. In Treatment Group 2, 18 out of 63, i.e. 27%, achieved A symbols for Maths). The students who increased their final symbols for Science in Treatment Group 2 were also the students whose reading posttest averages had improved after the reading programme. In Treatment Group 1, two students whose reading posttest averages had increased during the year, were also able to increase their symbols for the final Science exams. One of the students who achieved an E symbol in June was able to increase this to a B symbol for Science in the final exam.

It was also not within the scope of this research to formally assess any change in the written ability of Treatment Group 2 as a possible result of a reading programme. However, the reading programme included many written exercises and, as the facilitator of this programme, I was able to make the following observations.

Many students were unable to write coherent paragraphs or summarise texts in the June examinations. These students could be termed functionally illiterate. Reports from colleagues verified this. The students' knowledge of syntax, vocabulary and spelling was limited and their attempts at writing paragraphs or essays reflected this.

In the final English examination in September, it was very encouraging to mark summaries and paragraphs which were not only largely coherent but which included interesting vocabulary and correct spelling. The weak students, in particular, produced very pleasing work and, as described earlier in this section, rewrote the Senior Certificate English examination and improved their scores by at least one symbol.

Constant exposure to good expository texts seemed to impact on the students' own writing. By the end of the year, they were more confident in using topic sentences and paragraphs and their work showed far more attention to details such as spelling, the use of conjunctions and correct grammatical structures. When asked how they thought the reading programme had benefitted them, many students commented on their increased ability to summarise texts which then helped them in note-taking and studying for exams. They also commented on their improved reading ability and reading rate.

As a final comment, some of the participants of this 2003 research group who went on to study various degrees in Science at Wits University visited the College during 2004. All commented on the amount of reading they are required to do at university and how they feel that they are coping with this and with the written responses they are expected to produce for their lecturers.

4.7 Conclusion

The findings of the statistical analyses of the data collected for the current study were presented in this chapter. In addition, qualitative information and an insider perspective have also been presented to describe the quasi-experiment that took place in 2003. While a null hypothesis had to be accepted for Hypothesis 1 posed by the current research (cf.§4.4.2), other information gathered seemed to indicate that an intensive reading programme may indeed be of use for improving performance in an academic subject like Science. The null hypothesis HO2 was rejected on the grounds that significant relationships between reading ability and performance in Science were found in both Treatment Group 1 and Treatment Group 2. This suggested that extensive and intensive reading practise could be linked to improved academic performance in Science. It was also suggested that combining extensive and intensive reading in a reading programme would be of the greatest benefit for students, especially if the intensive reading module involved the reading of scientific texts.

CHAPTER FIVE

CONCLUSION

5.0 Introduction

This chapter reiterates the aims of the current study and reviews the information presented in the previous four chapters. It further summarises the main findings of this current study. Subsections 5.3 and 5.4 examine the contributions and the limitations of the study. Subsection 5.5 suggests areas of future research in reading.

5.1 Review of the aims of the current study

The current study set out to examine the effects of implementing an intensive reading programme on a group of ESL post-matric students during a bridging course of one academic year. The study further examined the relationship between reading skills and Science, an academic subject, which relies inter alia on the ability to read, comprehend and solve word problems.

Chapter One identified some of the problems experienced by ESL students from disadvantaged backgrounds when faced with studying a subject like Science at tertiary level. At this level, students have to 'read to learn' and as most of them have been taught to learn by rote memorisation, their task is daunting. Most of the students have also not been specifically taught reading skills or vocabulary strategy skills and they have great difficulty in understanding academic texts. Factors such as underqualified teachers, inadequate facilities and inadequate textbooks or lack of access to textbooks have further hampered the students in their studying of academic subjects at secondary level. Science as a subject presents difficulties for students as well. Students have to read and comprehend expository scientific texts in order to solve problems and few have the vocabularies or the reading skills to do so. As a result, ESL students are often unable to cope with the academic demands of tertiary study and many fail or drop out of Science or other courses. In addition, placement testing procedures for tertiary institutions, (if there are any), often do not specifically test reading

ability, and enrichment courses do not focus adequately enough on reading skills to assist students, when they begin their tertiary careers at universities and technikons.

The upshot of this situation is that fewer Science students are graduating and the pool of qualified Science personnel is dwindling in an expanding economy.

This chapter also presented the two hypotheses that were to be explored in the current study. The first explored the effects of a reading programme on reading skills, namely, does reading improve reading? The second hypothesis explored the relationship between reading skills and academic performance in Science. The latter relationship has, thus far, hardly been investigated or examined.

Chapter Two reviewed the literature pertaining to this current study. Research regarding reading and academic success, reading and its effect on vocabulary, and reading and its possible effect on performance in Science was presented. The consensus of opinion was that academic success was linked to reading skill and that practising reading improves reading. In addition, the implementation of reading intervention programmes and their success in both South Africa and overseas were discussed. It was noted that very little research had been done on the link between reading and success in Science, and that this link was what the current research hoped to explore.

Chapter Three dealt with the research framework and procedures adopted for the current research. The current research was predominantly quantitative and experimental. It was hypothesis-driven and analytical. Two intact groups of post-matric ESL students from privately sponsored Colleges were used loosely as control and intervention groups (Treatment Group 1 and Treatment Group 2), and a reading intervention programme was introduced in Treatment Group 2. The groups wrote the same reading pre- and posttests and their English and Science results were collected during the year.

The current study consisted of a pilot study of six weeks in 2002, followed by a main study spanning one academic year (2003). The results of the pilot study, though incomplete, were also presented in this chapter. Owing to changed circumstances, the procedures adopted in the main study differed from those of the pilot study, but the overall research design remained the

same. (In the pilot study, a control and an intervention group were used, but for reasons detailed in the chapter, these terms were replaced with 'Treatment Group 1 and 2' in the main study). These procedures were dealt with at length in this chapter.

Chapter Four detailed the data collected during the main study and the analysis thereof. The results were tabulated and discussed. Although a null hypothesis had to be accepted for Hypothesis 1, as *t*- tests could not establish a significant difference in reading skills between Treatment Groups 1 and 2, further tests suggested that Treatment Group 2, particularly the weaker students in this group, had indeed benefitted from the reading programme. It was also established that Treatment Group 1 was a more homogenous group who were exposed to more English training during the year and who also proved to be academically stronger than Treatment Group 2. The latter group was more heterogeneous and had a far wider range of scores in both reading tests and Science results. These differences go some way in accounting for the fact that Treatment Group 2 did not outperform Treatment Group 1 in the final reading test scores. However, the significant gains Treatment Group 2 made between pre- and posttest scores are important to note, given that the exposure that this group had to reading was half that which Treatment Group 1 received.

For Hypothesis 2, the null hypothesis was rejected as Pearson Product Moment correlations suggested a significant relationship between performance in Science and reading ability in both groups which was very encouraging. In addition, a significant relationship was established between Science and vocabulary results in Treatment Group 2 which suggests that vocabulary strategy training is worthwhile when implementing an intensive reading programme. Qualitative information, together with information from my own insider perspective, was presented and again it seemed that improving reading skills contributed to better language skills, and thereafter to greater academic achievement in Science.

5.2 Summary of the main findings

Treatment Group 2's overall improvement in pre- and posttest reading scores, reflected by *t*-test results, which were all significant at the $p < 0.05$ level, indicated that the students were beginning to benefit from the reading programme. This improvement suggested that the duration of the programme might possibly have been too short. More time was needed to show

more positive results. Treatment Group 1's results also showed improvement, but not as great overall as the former group's. Statistically, no significant difference was found between the two groups with regard to reading ability after the implementation of a reading intervention programme with Treatment Group 2, and a null hypothesis had to be accepted. Further, as extensive reading seemed to have benefitted Treatment Group 1, it seems feasible to suggest that developing reading skills (both intensive and extensive) might be a solution for ESL students hoping to enrol in Science course at tertiary institutions. Had it been possible to control the exposure factor such that both groups were exposed to reading in the classroom for the same amount of time, then differences may well have emerged between the two treatment groups. This is obviously an area that can be given attention in future studies. It was also noted that 65% of all the students in both the groups were still considered as reading well below the desired level, that is, at a level that would not meet the demands of tertiary education and would need some form of reading intervention programme in order to enable them to read at the required level.

Regarding the relationship between reading skills and performance in Science, both groups showed moderate (Treatment Group 2) and high (Treatment Group 1) positive correlations (Pearson Product Moment analyses) that were significant at the $p < 0.001$ level. These results indicate that a robust relationship between reading ability and performance in Science does exist and that specifically teaching reading skills (intensive and extensive) via reading programmes to ESL students positively contributes to their performance in Science.

The range of raw scores of the two groups in reading pre-and posttests and Science showed more clearly what had transpired through the year. There seemed little doubt that improved reading skills as a result of practising reading, both intensive and extensive, had affected language proficiency and this improvement positively contributed to academic performance in the final National Senior Certificate examinations in Science. The students in both groups achieved commendable results in the latter examinations (cf. §4.7) and many of the students improved their results by at least one symbol. In almost all cases these same students had improved reading scores, which suggests that improved reading skills had contributed to their performance in Science. For example, of the four students who achieved A symbols for Science in Treatment Group 1, three had improved their reading scores from pre- to posttests.

In Treatment Group 2, six out of the eight students who achieved A symbols had also improved in reading scores.

Both groups' vocabulary scores improved, Treatment Group 2's marginally more than those of Treatment Group 1. This finding suggests that teaching vocabulary strategies, together with reading skills, produced beneficial results. This was further indicated by the significant relationship that was established between vocabulary and Science in Treatment Group 2, but not in Treatment Group 1. This pattern possibly suggests that vocabulary strategies, if specifically taught in conjunction with reading skills, (as in the case of Treatment Group 2), can contribute to performance in Science.

Although the assessment of the reading rates of the participants offers only a rough measure of their reading speeds, the results in general suggested that, after a year of reading, the students read faster and comprehended more. Nevertheless, in terms of the suggested criteria for reading rates (cf.§2.5), 80% of the students were still reading too slowly for the demands that tertiary education would put upon them.

Qualitative data collected showed that the students were aware of the value of reading but found the task daunting. The information also clearly indicated that the students in both the pilot and the main study preferred silent reading and not group work. My own insider perspective revealed that writing skills improved in Treatment Group 2 and it seems reasonable to suggest that reading consistently helps to improve writing ability. After regularly being exposed to well-written expository texts, it appeared that the students began emulating the style and structure of these texts in their own writing. The quality of their written work thus improved. In addition, the spelling ability of both groups improved and it was suggested that constant exposure to the printed word could be a contributory factor.

5.3 Contributions of the study

Reading is considered vital for academic success (Jardine 1986; Dreyer 1998; Pretorius 2002), yet it is not a skill that is often explicitly taught to students. In addition, in South Africa not many empirical studies exist that explore the relationship between reading and academic success. The current study explores this relationship and the findings of the current study

suggest that both intensive and extensive reading play an important role in preparing students for future academic study and, in conjunction with vocabulary strategies, should be explicitly taught. There also seems little doubt that reading improves reading and therefore it is a skill that needs to be practised on a regular basis. Literacy cannot develop in a void and so time needs to be set aside for developing reading skills, as the longer the exposure to regular reading, the more reading skills develop and improve.

The current study also explored the value of vocabulary strategy training during the implementation of the reading programme. The findings suggest that such strategy training also seems to benefit the students. The students' vocabularies improved and this in turn contributed to their improved reading skills. Improved vocabulary usage was also reflected in their writing.

The relationship between reading skills and academic performance in Science has not been thoroughly explored either and a contribution of the current study was that this relationship was investigated. The current study implemented a Science reading programme to specifically assess this under-researched relationship. The findings of the current study do indicate that there is a strong relationship between reading skills and academic performance in Science. It would appear that as reading ability increases, academic performance in Science also improves. Reading ability seems to facilitate language development in ESL students. This in turn facilitates meaningful learning in Science. Poor reading ability seems to hinder students from reaching their potential in Science. It thus seems worthwhile to explore this relationship further in the hope of equipping more students with the abilities they need to successfully pursue courses in Science.

The reading rate results of the students in the current study clearly showed that they are reading at a rate far below what is required of them for tertiary study. In addition, their rates of reading are too slow to cope with the academic demands that will be placed upon them. Reading abilities are only acquired through extensive exposure to books over a period of time and the students in the current study had not had this advantage in their school careers. Furthermore, many had not had access to books in their disadvantaged communities. As the students who participated in the current study are representative of the thousands of ESL students who will enrol at tertiary institutions, it does not seem unreasonable to anticipate that

these would-be graduates will also be inadequately prepared for tertiary study. Their chances of actually graduating would appear to be slim unless they are assisted by enrichment programmes provided by the tertiary institutions. Specifically, the students should be exposed to reading programmes to enable them to cope with the language demands that they face. The time and money spent on such programmes would be worthwhile as less money would be wasted in the long run on failures and drop-outs. Uniform admission testing at institutions would also help in this endeavour and students could be guided into enrichment programmes or redirected to more suitable areas of study.

Of further interest in this current study was a brief exploration of the relationship between reading and writing. This is an area that also merits further research because it appeared that as reading was practised, writing skills improved. The latter skills included a better spelling ability and a more extensive vocabulary. Students will read and write their way through tertiary courses and by concentrating on giving training in these two areas, tertiary institutions can assist their students in achieving greater academic success.

5.4 Limitations of the study

Although care was taken with the design of the current study, certain unforeseen problems arose in the main study of 2003. Of central concern was the fact that the 'control and intervention' groups (i.e. Treatment Group 1 and Treatment Group 2) used were intact groups (one 'borrowed' from another College) and as the year progressed, it became obvious that the groups were not as equivalent as initially believed. This situation arose from circumstances beyond my control, in that I was not able to use a control group from within our College because of ethical objections raised by Management.

Treatment Group 1 was a more homogenous group as their results and ranges of results indicated. Academically they also proved to be a stronger group. In addition, this group was exposed to eight hours of English per week. This latter factor weakened the internal validity of this study, but this was a factor beyond my control. In contrast, Treatment Group 2 comprised students with a greater range of abilities in all subjects and thus an academically weaker group. They were also only exposed to four hours of English training per week, two hours of which were devoted to the reading programme. Comparing these two groups was therefore

problematic and the improvements that Treatment Group 2 showed in reading ability were not as obvious as they could have been with a more equivalent control group. However, it was very pleasing to see how both groups improved during the year and to chart their subsequent success in the National Senior Certificate examinations. I have no doubt that their English training assisted them in these results. The achievements of the two groups also endorse the value of bridging/enrichment programmes such as those run at the two privately-sponsored Colleges involved in the current study.

A second limitation of the current study was that of the time factor. Firstly, the students were only exposed to the reading programme for one academic year because of the nature of the bridging course. Their improvement in reading ability was only just becoming evident before the year was over. It would have been interesting to follow the students' progress had the reading intervention programme spanned two or even three years. As discussed in Chapter Two (cf. §2.4.1), skill in reading develops over a period of time with practice. One academic year was possibly not long enough to show the benefits of a reading programme, especially for students who initially had very low reading levels. Secondly, time – or the lack of it – affected testing procedures and the implementation of the reading programme. Students missed pre- and posttests because of interviews with sponsors and College activities. Fewer units of the reading programme were completed partly also as a result of College activities, for example internal examinations. Another reason for fewer units being completed, was that I had not anticipated needing more than one set of reading manuals for one 'intervention class', but the change in procedures for the main study necessitated more manuals and no financial provision had been made for this. The students were thus unable to complete the units for homework, all their work was completed in class and this slowed the reading programme down. Finally, the unfortunate timing of the reading tests in some cases due to timetabling, for example, on the first day of term or in the afternoon, affected the students' results and they may not have performed as well as expected.

A third possible limitation of the current study was with regard to the tests and their administration. There is a lack of standardised reading tests available in South Africa and I therefore set the tests myself. However, I was theoretically informed from my research reading and I had help from more experienced testers. The pilot study was in part used to 'test' the reading tests and from certain problems revealed during the pilot study, I was able to revise

the tests for the main study. The alpha (Cronbach) test showed satisfactory reliability scores for the reading tests.

In both groups, the tests had to be administered when they could be, that is, during class time with breaks, and possibly this was not always ideal, but on the whole, judging from the results, a satisfactory standard was maintained in both groups.

5.5 Implications for further research

As discussed before, it seems worth exploring the effect that reading training over an extended period has on reading skill. The current study describes a reading intervention programme of only one academic year, and while the benefits were beginning to show, a more extended period of training in reading could possibly produce more definitive results. A reading programme of longer duration might also highlight the relationship between vocabulary strategy training and reading, as well as that of reading skill and writing ability (including spelling ability). Positive results in these areas could possibly also alert the staff of tertiary institutions to the value of uniform and valid language testing procedures. Many so-called 'reading tests' used in the past did not actually tap into the students' reading abilities, they tested other language abilities, for example, vocabulary skills. Tertiary institutions could also be alerted to the value of implementing enrichment programmes which emphasise reading as a vital skill for improved academic performance. In addition, comparisons and the critical examination of differences between different reading programmes is also needed. For example, to examine how extensive versus intensive reading programmes improve reading and academic performance, or whether vocabulary instruction should be included in a reading programme or not.

Another aspect of reading that needs further investigation is that of the relationship between reading rate and comprehension amongst L2 readers. As discussed in the previous chapter, some students read very slowly in test situations, yet their comprehension is good. Others, however, 'read' (rather skim) too quickly to absorb and retain what they are reading. Also of concern, are those students who read too slowly, and this affects their ability to comprehend, which in turn affects their performance in examinations. Investigating the relationship between reading rate and comprehension could further aid teachers/lecturers in training their

students in these skills, so that the students can cope with the academic reading demands made of them at tertiary level.

It would appear from the findings of the current research that there is indeed a link between reading ability and academic performance in Science. It therefore seems plausible to suggest that this relationship is explored more fully by researchers, in order to benefit ESL students who intend to pursue courses in Science at tertiary level.

From anecdotal evidence, another interesting observation to emerge from the current study was the students' preference for individual, silent reading as opposed to group work, which is a cornerstone of the current Outcomes Based Education (OBE) system adopted in South Africa in 1995. The implications of this finding could be far reaching and in the interests of the students, merits further investigation.

Finally, although beyond the scope of the current study, other research studies (e.g. Taillefer & Pugh, 1998) have investigated the relationship between L1 and L2 reading ability. Because of the multilingual abilities of many ESL students, it would be interesting to explore this relationship in South Africa. Of further interest might also be the possible relationship between reading ability in a specific language, for example, Zulu which has a fairly large base of printed, written material, and English, as compared with another official Black language and English in South Africa. It might be interesting to assess whether the transfer of reading skills to English is more readily achieved from certain Black languages than others.

5.6 Conclusion

Reading is considered a vital skill for the pursuit of any academic study, yet it is a skill that is seldom explicitly taught to students. If it is ever taught, then it is seen as the English teacher's task to do so. The notion that reading ability is the basis for the study of any subject seems to be overlooked by other disciplines. South Africa seems to be producing a frightening number of largely illiterate matriculants, as statistics indicate (cf.§1.1). These students move on to tertiary study and there, many fail or drop out. In consequence, the pool of qualified people in all fields is dwindling. Concerned private sectors of the economy are attempting to address the situation by sponsoring enrichment courses, but not only are there too few sponsors, they are

also failing to address the real issue – that of inadequate language proficiency, particularly among Black students. As reading ability is an intrinsic part of language proficiency, it seems reasonable to concentrate on improving this skill.

Increasing numbers of students are enrolling for Science and Maths courses at tertiary level in response to appeals from Education Departments and the private sector. There is a very real shortage of qualified personnel in these fields and it is affecting the economy in general. Yet, despite the increasing enrollments in Science and Maths, very few students are graduating in these disciplines and one of the reasons for this is that the students lack the reading and writing ability that they need to achieve academically. Science, in particular, does require that students are competent readers and writers. Academic performance in this subject is hampered by poor reading/writing ability. As shown in the current research, improving reading skills has a positive effect on performance in Science.

It seems reasonable to suggest then, that a very concerted effort is made by all those concerned to improve students' reading skills and thereby their overall academic performance. Without the necessary academic skills, students will continue to fail or drop out in Science and other disciplines. Unless these issues are addressed, fewer and fewer qualified individuals will be found in the workplace and a crisis looms for the economy of South Africa.

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